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MANAGEMENT AND ADMINISTRATION

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Authors and Articles in this Issue

ANDREW W. MELLON, Secretary of the Treasury, in the opening article of this issue emphasizes the great importance of industrial research to all human progress. As an eminently successful business man, Mr. Mellon was drafted for the stupendous task of readjusting the national finances during the trying period following the close of the war. By his comprehensive grasp of affairs he has accomplished economies of administration and reductions of public debt that place him in the front rank of financiers of all time. **Harry Dean Gidney**, Statistician of the Pacific Telegraph and Telephone Company, contributes "Developing the Statistical Department." The modern business constantly tends to greater size, and its larger operations and the keen competition it must meet render it imperative that the executive keep in even closer touch than before with its essential details. How can this be done? The answer is found in Mr. Gidney's article.

The General Motors series, which promises to constitute a distinctive contribution to the literature of management, begins in this number with "Mobilizing the Cash Reserves," by **Alfred H. Swayne**, Vice-President of General Motors Corporation in charge of banking relations. Mr. Swayne describes the methods by which the present management of the corporation effected large interest savings by the economical use of working capital.

J. H. Bliss, Controller of Libby, McNeill and Libby and author of "Financial and Operating Ratios in Management," contributes the second article of his series, "Capital Requirements and Control". Mr. Bliss calls attention to the meager information for the average reader provided by the usual financial statement. He then shows what a wealth of information the same statement yields to the accountant, or other person who knows how to "read it out".

"Planning the Repetitive Manufacture of Automobile Wheels" concludes the series by **William B. Ferguson**, which has presented in six articles the principles of accepted methods for planning both repetitive and non-repetitive work. Mr. Ferguson is exceptionally qualified to deal with this topic.

In the concluding instalment of **Dean Dexter S. Kimball's** series, entitled "The Rise of 'Industrial Democracy'," he sketches the influence of democratic ideals on industrial development, culminating in the establishing of something like 1000 works councils in this country since the war. Dean Kimball writes from intimate knowledge of industrial conditions, having occupied positions from machinist apprentice to general manager.

Frederick A. Waldron, Consulting Engineer, formerly superintendent of the National Cash Register Company, contributes the first article of a series of five which will present a complete simplified system of manufacturing control. The subject is "A Co-ordinated System of Planning, Routing and Cost Accounting".

"Establishing Standard Cost," by **R. W. Darnell**, Controller of the Ritter Dental Manufacturing Company, is the fifth article discussing "Increased Profits Through Control of Costs." It discusses briefly the job and standard cost systems, and then deals in greater detail with the preferable standard cost system.

Sales and collection men will find useful material in the article by **E. G. Reynolds**, formerly of the Tidewater Oil Company, on "Co-ordinating Production and Sales for Oil Companies," and that by **J. W. Hallman**, Credit Manager of the Sun Oil Company, on "Cost of Carrying Overdue Accounts".

The **Fordham-Tingley** article this month deals with the compilation of the budget. The authors show in detail the process of laying out the preliminary budget plans, developing them down through divisions, departments, and sections, and finally assembling all data essential to the building of a sound, comprehensive, operating program.

Henry Parker Willis, Editor of *The New York Journal of Commerce*, and Professor of Banking in Columbia University, contributes "Picking Out Your Bank". Mr. Willis lays down five canons for the selection of a bank—size, location, scope, service, expertness.

George E. Titcomb, Eastern Branch Sales Manager of the McMyler-Interstate Company, describes 8 typical industrial installations of mechanical coal-handling apparatus, covering small and large plants.

David B. Porter, Assistant Professor of Industrial Engineering, New York University, contributes an article on "Applications of Charts in Industry", which will be valuable to all who are interested in graphic representations.

The Experiment

Its Use and Abuse in Business Management

Experiment is the re-creating life-blood of Progress. It is necessary when confined to new and unsolved problems in business management and control. But too often Experimenting is only another word for "Guessing"—blind striving after the right system or practice which already exists and which experience has established as exact knowledge. In such cases experiment is a costly and wasteful pastime.

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THE PUBLISHERS' PAGE

The Current Information Index

THE new department "Current Information Index for the Management," in this issue of MANAGEMENT AND ADMINISTRATION beginning on page 104, rounds out plans for the magazine which have been maturing for many months. This January number is, therefore, typical of those that will follow during 1924. Each will have from 12 to 15 major articles and 5 service departments, all selected and prepared for their usefulness and practical value. These two characteristics are prominent in the new index.

THE field of management and administration is so broad, and the published matter in regard to closely related topics is so voluminous, that a focusing point is needed by anyone who would keep in touch with all the worthwhile management developments. The "Current Information Index" is that point. It gives in a few pages the essential facts concerning about 200 current magazine articles, books, pamphlets, and printed addresses and reports. A glance through its pages is turning a spotlight on the best of present-day management thinking and doing in all branches of industry.

ONCE spotted it is easy to secure and apply these articles which are of use in solving your management problems. And a single source has brought them to your attention. You have been saved time by consulting one section of MANAGEMENT AND ADMINISTRATION instead of reading a score or more of magazines in an attempt not to miss anything which might be helpful.

The grouping of all articles under alphabetic heads permits passing over those which are not of use and concentrating only on those which promise assistance. If a subject is under investigation a survey of the items under that head in recent issues of the index brings forward all the available current information.

The index has one feature which has never before been introduced into such a compilation. Each item is classified and the index or class number is printed as a short title, to assist in grouping like items, or to permit clipping of items to be pasted on cards in a personal file. Those subscribers who are already using the classification of management information, under which the articles in the magazine are classified, will find this feature of the index invaluable. The other facts given in regard to each article or book are: Its actual title; name of the author; name of the publisher or reference to its source; and a brief description of its thought or contents.

THE preparation of the items is done under expert supervision by the Engineering Societies Library in New York City. The articles and books to be indexed are selected by the editors of MANAGEMENT AND ADMINISTRATION.

To carry through the purpose of usefulness every book, pamphlet, and report indexed can be secured from its publisher; every magazine from which an article has been indexed is kept on file so that photostat copies of every article indexed can be supplied by us at cost.

The index section in this issue has been developed from about 150 magazines and the current books of about 50 publishers. In all 170 items are presented including 14 books.

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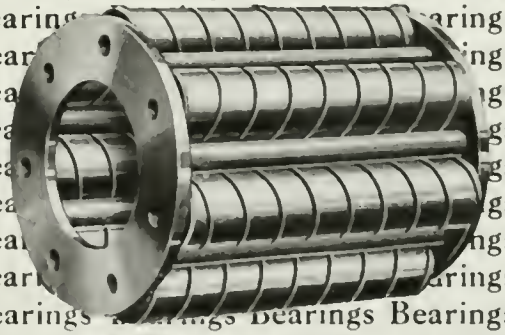

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P.38

CONDITIONS AND PROSPECTS IN BUSINESS AND INDUSTRY

PREPARED BY LEWIS H. HANEY

Director, New York University Bureau of Business Research

Barometer of Industry and Trade

Outlook is Promising for Good Business during 1924

The main forecasting line in the barometer, the P/V line, moved upward decidedly in November. As this line usually indicates the course of business five or six months in advance, it now seems probable that the upswing which we have forecast for 1924 will be somewhat greater and cover a longer period than had been anticipated. Clearly the trend of the P/V line shows that the basis is being laid for a very good business during a considerable period beginning about three months ahead.

The rise in the main forecasting line is the result of a moderate advance in prices accompanied by a decrease in the physical volume of trade. The latter is due to the curtailment in production and trade which began in the summer and which is apparently nearing its close at the present time. As a result, oversupply is being reduced and the intensity of demand for commodities is increasing.

As a result of this condition the outlook is for a general upward trend in prices during the early part of 1924. With oversupply remedied in most industries, with money easy, and with the intensity of demand increasing, higher prices are the logical outcome.

The forecast of an upward trend for business and industry is supported by conditions in the money market. The interest rate on the best commercial paper stands at 5 per cent, and, when allowance is made for the usual seasonal variation, this means a virtual decline in money rates. The federal reserve ratio has actually increased and after adjustment for seasonal variation, stands near the highest point ever reached. This fact reflects the existence of abundant credit.

One of the few disturbing indications has been the increase in the number of business failures. This increase reflects the extremely "spotty" state of trade—some industries being very good, while others are equally bad. On the whole, the failure statistics suggest that no general increase in business is immediately at hand; but we may reasonably assume that the gain in failures reflects the last stages of the recent period of liquidation, and that the advance need not be long delayed.

The unfavorable appearance of the failure data is in part offset by the large gain in new business enterprises.

Already a real upward tendency is reflected in the November statistics of bank debits and postal receipts. (See Fig. 9). Bank debits to individual accounts furnish one of the most valuable and sensitive indexes of business condi-

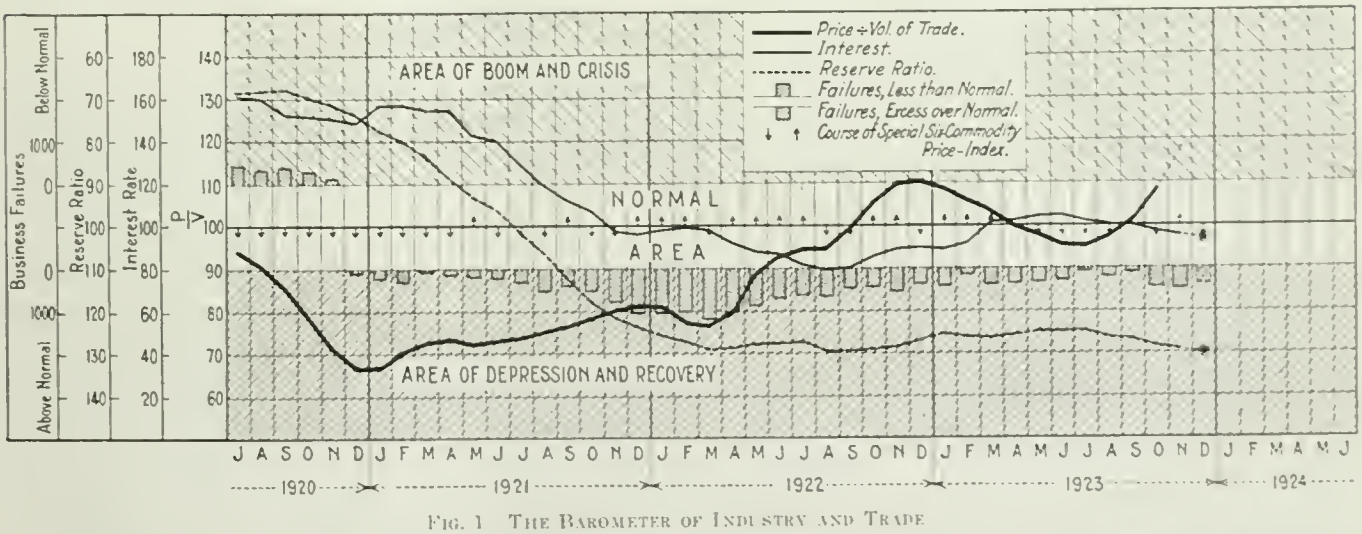

Price÷Vol. of Trade.
Interest.
Reserve Ratio.
Failures, Less than Normal.
Failures, Excess over Normal.
Course of Special Six-Commodity Price-Index.
AREA OF BOOM AND CRISIS
NORMAL AREA
AREA OF DEPRESSION AND RECOVERY
Business Failures
Below Normal
Above Normal
Reserve Ratio
Interest Rate
P/V
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1920
1921
1922
1923
1924

FIG. 1 THE BAROMETER OF INDUSTRY AND TRADE

The P/V line (drawn heavy) is the main forecasting line. It shows the trend of commodity demand, and is the ratio between Bradstreet's index of wholesale prices and the physical volume of trade (carloadings times tons per car), based on 1912 as the normal year. It is plotted as a three months' moving average, centered successively on the middle months, except that the final dotted portion of the line runs to the actual figure for the last month. A rise in the curve indicates increasing demand, and vice versa. The interest rate curve has been corrected for seasonal variation, and index number 100 equals 5 per cent. The federal reserve ratio of cash reserves to note and deposit liabilities is inverted to harmonize its indications with the rest of the curves, and is corrected for seasonal variation. Business failure bars are based on Dun's reports, and normal is taken as the trend for 40 years. The six commodity price index is based on special investigation by the N. Y. U. Bureau. December 1923 data shown are probable trends. Areas in which curves lie indicate that business is good normal, or poor.

tions. The fact, therefore, that bank debits, after eliminating seasonal variation, increased nearly 9 per cent in November as compared with October, is one of the outstanding developments of the month. Postal receipts also gained, though to a smaller extent.

The best indications available with respect to purchasing power strongly support the forecast based on the P/V line. The New York University Bureau of Business Research prepares a monthly index of consumer purchasing power for New York State. This increased sharply in October and a continued high level was maintained in November. Furthermore, there has recently been a gain in the indicated purchasing power of wage-earners which is of great importance. While employment appears to have decreased somewhat, it still remains high and the average weekly earnings of wage-earners have increased decidedly. In fact, earnings have moved up so much more than the cost of living index that the outlook for demand among wage-earning classes is very much brighter. (See Fig. 14).

Since activity in the building trades played so important a part in the 1923 business peak and recession, and since it is likely that it will have an important influence on business conditions in 1924, the latest building statistics deserve careful study. They show that contemplated new construction made a large gain in November, and the contemplated construction index often leads contracts awarded by several months. While no positive forecast would be safe, and none is here made, it seems reasonable to state that the increase referred to makes it rather likely that there will be a high level of building activity in the spring. While contracts awarded for residence construction decreased in November, there was an upturn in the volume of contracts for business and industrial buildings which anticipates by a month or two the usual trend at the turn of the year. This is a favorable indication concerning the demand for steel and other heavy building materials.

Unfilled steel orders continue to decline, but the indication is that the figure will reach the bottom about February 1924, in which case our favorable forecast will be confirmed by another important business indicator.

A favorable factor in the industrial situation lies in the reduction or stabilization of some of the chief items in operating expenses. Fuel, both coal and oil, is cheap and promises to remain so for some time. With the employment index moving downward, there is, temporarily at least, some promise of an easier labor market. On the other hand, as liquidation in overstocked industries is completed, the trend of prices should be upward, thus insuring a better operating margin in industry as a whole. Reasons have been given for anticipating increasing demand for commodities. It seems, therefore, that the stage is being set for higher earnings in the first six months of 1924.

Outlook for 1924. From our analysis of prospects in business and industry the conclusion is that there will be a general rising trend during the first six months of 1924—probably during the first nine months. Of course, no one can see clearly beyond a period of that length, but it may not be out of place to suggest a warning with reference to the probable situation toward the close of 1924.

In the first place, certain important industries are in such shape that it seems hardly probable that another year can go by without a thorough liquidation and reorganization. The cotton textile industry is caught between very high raw materials and a market which threatens to rebel against higher finished goods. The leather industry may require a reorganizing process. The copper industry is in danger of overproduction. The stocks of gasoline are abnormally large and have increased steadily, when allowance is made for seasonal factors. A serious situation is likely to arise in the automobile industry before the next season ends. It is entirely possible that a crisis may come in the building industry should there come a runaway market for labor and materials next year.

In the second place, the October rise in the index of production of basic commodities suggests the possibility of overproduction before the end of 1924.

In the third place, there are some indications that wholesale distribution may begin to exceed retail distribution before long. If this trend is continued we may have a situation such as arose in 1920 when retailers in general overstocked.

Finally, in the fourth place, the cost of living is mounting steadily and it may be pointed out that the average American is spending an unduly large part of his income for rent, automobiles, radios, etc., —a situation which does not furnish a sound basis for enduring prosperity.

It would not be surprising, therefore, to see the beginning of a crisis and depression about the end of 1924. This is all highly tentative and merely suggests possibilities which should be watched.

Production and Stocks of Commodities

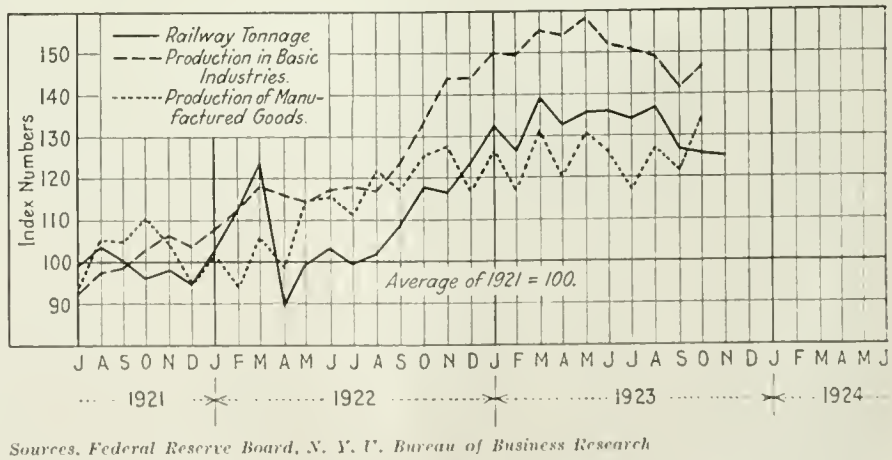
Production Increases: Stocks Still Need Adjustment

Stocks of Important Commodities

Gasoline stocks, after eliminating seasonal variation, show a rise of 3.5 per cent. Zinc stocks have risen about 20 per cent, but in view of the low point to which the stocks of zinc had fallen this change does not seem to indicate oversupply. Stocks of automobile tires have again registered a decline which shows that the tire industry is still in process of liquidating its excess stock. Stocks of cotton-seed oil show a marked increase, and cattle leather and pig iron show no improvement.

Production and Railway Tonnage

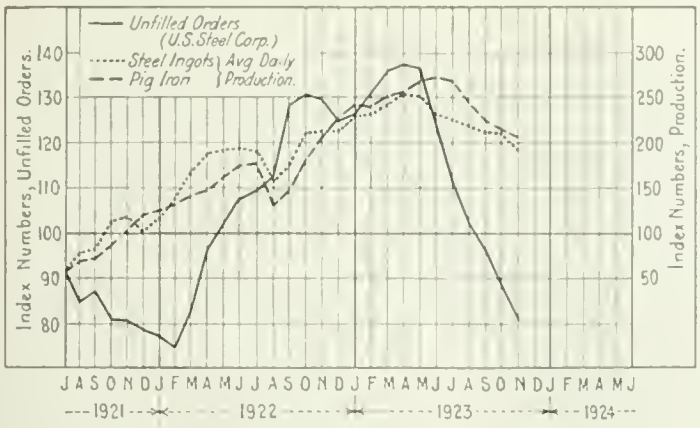
Production. During October, the latest month for which data are available, production in basic industries and in manufactures increased sharply. (See



Sources, Federal Reserve Board, N. Y. U. Bureau of Business Research

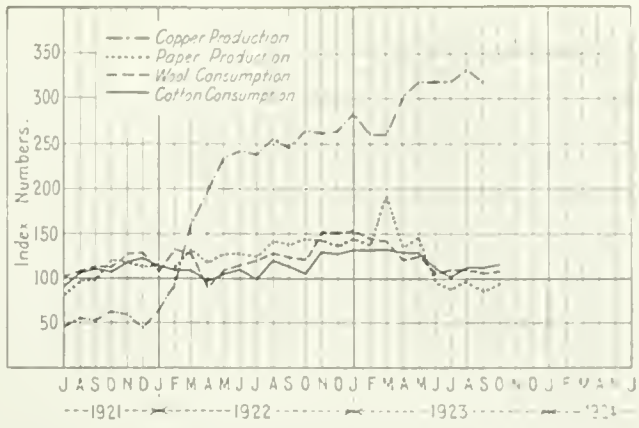
FIG. 2 RAILWAY TONNAGE AND PRODUCTION IN INDUSTRY

Railway tonnage and production in basic industries corrected for seasonal variation, and the latter also for normal growth.



Sources, Iron Age, American Iron and Steel Institute

FIG. 3 IRON AND STEEL PRODUCTION AND UNFILLED ORDERS Corrected for seasonal variation. Average of 1921 = 100.



Sources, American Bureau of Metal Statistics, Federal Trade Commission; Bureau of Census; Dep't of Commerce.

FIG. 4 PRODUCTION IN FOUR IMPORTANT INDUSTRIES Cotton and wool corrected for seasonal variation. Average of 1921 = 100.

Fig. 2). The index of production in basic industries is adjusted for seasonal variation and the increase in that index is, therefore, especially significant. The increase in manufacturing activity was largely seasonal.

It is worth noting that both of these indexes are almost exactly 10 per cent over October 1922.

Railway Tonnage. The index of railway tonnage which declined in October was slightly lower again in November after eliminating the merely seasonal fluctuation.

Conclusion. There was clearly a revival of industrial production in October which bids fair to maintain a level far greater than that of 1922. The divergence of production and railway tonnage, however, suggests that production may be again tending to exceed shipments with a resulting accumulation of stocks. If this condition is long continued, it will lead to unfavorable developments.

Iron and Steel Production

Production. During October the average daily production of pig iron declined 6 per cent from the previous month's level. (See Fig. 3). Some of this decline was merely seasonal and after eliminating that factor the net decrease is found to be only 4 per cent. Steel ingot production showed a decline of about 9 per cent from the October level. The data follow:

	Average Daily Production (Tons)	
	Pig Iron	*Steel Ingots*
Oct.	101,586	131,400
Nov.	96,476	119,800

Unfilled Orders. Unfilled orders of the U. S. Steel Corporation as of November 30, were 4,368,000 tons, or about 93 per cent of the October 31 amount of 4,672,825 tons.

Unfilled orders of Merchant Pig Iron as of October 31, show a further decline, being 16 per cent below the September 30 level. The unfilled orders as of October 31 were 616,722 tons. Merchant stocks increased about 8 per cent during the same period.

There has been a recovery in the pig iron market lately, and the total amount sold during November has been estimated at one million tons. All this is for the first quarter of 1924. The prices of iron advanced one or two dollars in all markets, but the buying movement ceased abruptly almost as soon as the prices advanced. Most of the iron sold during this movement was sold at the lower prices and not at the higher ones. Steel prices have remained firm and the *Iron Age* composite index of steel prices remains unchanged at $2.775.

Conclusion. Because of the relapse in pig iron sales which followed the price advances, we feel confident that *no new advance is likely in the price of pig iron for some time, but rather that a slight decline is more to be expected. The steel market is steady and no decline in price is anticipated.*

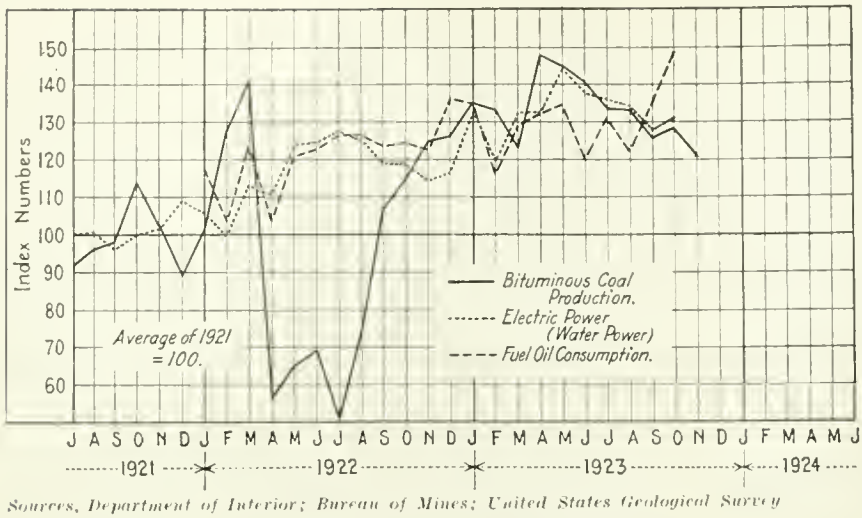
TABLE 1. STOCKS OF IMPORTANT COMMODITIES ON THE FIRST OF THE MONTH
(Index Numbers. Average for 1921 = 100)

MONTH AND YEAR	GASOLINE*	LEATHER, CATTLE	ZINC	NEWSPRINT PAPER	AUTOMOBILE TIRES	RAW SUGAR	COTTONSEED OIL	MERCHANT PIG IRON	DEPT. OF COM INDEX OF STOCKS—31 COMMODITIES
	100 = 630,757,000 gals	100 = 19,742,100 pieces	100 = 77,202 tons	100 = 30,099 tons	100 = 1,364,000 tires	100 = 114,000 tons	100 = 255,400,000 lbs	100 = 634,950 tons	100 = 139.7
July 1921	103	100.5	116.4	88.7	95.2	109.0	118.5	100.5	97.6
Aug. "	103	99.5	119.7	85.0	89.2	77.0	123.0	100.0	93.5
Sept.	108	99.5	112.1	90.4	90.2	87.0	129.5	94.0	93.8
Oct.	103	96.4	105.1	100.8	76.6	116.0	69.0	82.0	94.7
Nov.	102	95.9	91.7	76.7	81.2	69.0	71.0	80.0	93.7
Dec.	102	95.2	86.8	77.1	89.6	96.0	84.0	86.0	95.2
Jan. 1922	103	98.5	78.5	79.8	81.7	95.0	92.0	90.5	92.8
Feb.	110	99.0	85.1	88.5	95.6	88.0	84.0	86.0	90.6
Mar.	110	100.7	83.1	92.7	107.5	136.0	82.0	84.5	89.8
Apr.	110	95.4	78.1	93.9	118.8	183.0	84.0	70.0	85.9
May	110	101.5	67.0	82.9	125.2	140.0	89.0	52.5	76.0
June	111	101.6	52.3	82.6	126.6	105.0	82.0	49.0	74.5
July	114	98.3	38.3	77.9	115.5	107.0	84.0	38.0	73.8
Aug.	123	97.4	37.1	70.5	110.8	151.0	87.5	25.0	71.3
Sept.	133	91.5	28.0	66.3	106.1	132.0	89.0	23.8	76.2
Oct.	146	90.2	24.4	62.7	105.7	122.0	37.0	25.0	88.0
Nov.	161	87.7	23.1	65.8	107.3	70.0	35.0	23.8	88.9
Dec.	160	85.9	25.3	65.4	113.8	55.0	42.0	35.8	89.7
Jan. 1923	156	85.3	23.6	64.0	105.1	55.0	52.0	43.0	84.5
Feb.	156	84.0	21.5	76.7	107.6	76.0	60.0	44.0	79.1
Mar.	154	82.6	14.1	77.3	119.7	86.0	64.5	38.0	78.9
Apr.	162	81.6	13.0	67.2	129.9	168.0	67.0	41.7	73.6
May	161	81.4	11.6	62.9	130.3	147.0	69.0	53.6	72.4
June	173	82.1	16.9	60.5	139.6	97.0	71.0	72.7	72.6
July	174	82.8	22.2	65.0	161.4	97.0	76.0	97.5	73.8
Aug.	185	83.6	27.5	71.0	148.0	96.2	71.0	111.0	75.9
Sept.	199	84.3	34.4	85.5	138.5	84.8	57.4	121.7	
Oct.	206	84.2	29.6	82.2	123.2	139.4	28.0	131.0	
Nov	211	85.4	33.4	82.5	111.7	102.8	55.6		
Dec.			40.3						

* Last of month; adjusted for seasonal variation.

Production in Important Industries

Copper and Paper. Our index of the production of copper has declined be-



Sources, Department of Interior; Bureau of Mines; United States Geological Survey

FIG. 5 FUEL AND POWER PRODUCTION
Bituminous coal and electric power corrected for seasonal variation.

several pronounced changes compared with October. (See Fig. 6). According to the information of the F. W. Dodge Co., contemplated construction rose 15 per cent, while contracts actually awarded declined 50 per cent.

Contemplated Construction. The index of contemplated construction rose from 128.6 to 148.3, after due allowance has been made for the seasonal factor. This increase is about 15 per cent.

Contracts Awarded. The index of contracts awarded fell from 152 for October to 76 for November, a decline of 50 per cent. The index of contracts awarded for business and industrial buildings, however, rose from 112 to 122.6, a gain of about 10 per cent. If this rise continues we may look for an increased demand for iron and steel products.

tween August 30 and September 30 about 4½ per cent. (See Fig. 4). But stocks are still high and it seems that some degree of overproduction exists. During October the production of paper was about 12 per cent greater than during September. The October wool consumption increased but slightly over the September consumption, after allowing for the normal seasonal movement in this industry. In spite of some curtailment in cotton mill activity, the November consumption of cotton decreased only 2 per cent; the normal decline for this month is about 6 per cent, so that the index of cotton consumption shows a net increase.

Fuel and Power

Coal. The production of bituminous coal (Fig. 5) during November, after allowing for the usual seasonal change, decreased 6 per cent from the October level. The coal supplies are plentiful and there is no price rise in sight at present.

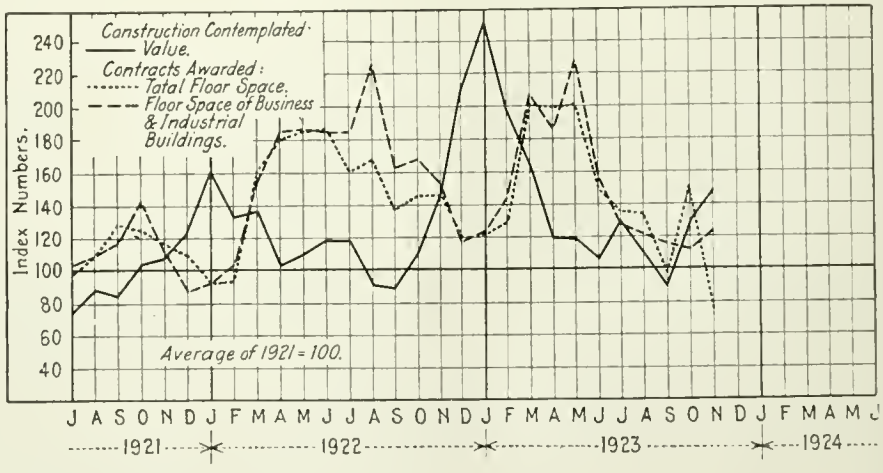
Fuel Oil. Fuel oil consumption was 10 per cent greater during October than during September, which shows still further and renewed activity in the industries using this fuel, and reflects the recent growth in oil burning installations.

Hydroelectric Power. Hydroelectric power production also increased during October. The index, seasonal variation eliminated, was about 2 per cent greater than during September.

Conclusion. An easy fuel market appears likely for some months. The apparent gain of fuel oil and electric power on coal is interesting.

Building Activity in November

Building activity in November shows



Source, F. W. Dodge Company

FIG. 6 BUILDING CONSTRUCTION AND FLOOR SPACE IN CONTRACTS AWARDED
Construction contemplated corrected for seasonal variation.

Trend of Trade and Finance

Trade Developing Steadily: Money Conditions Favorable

Exports and Imports

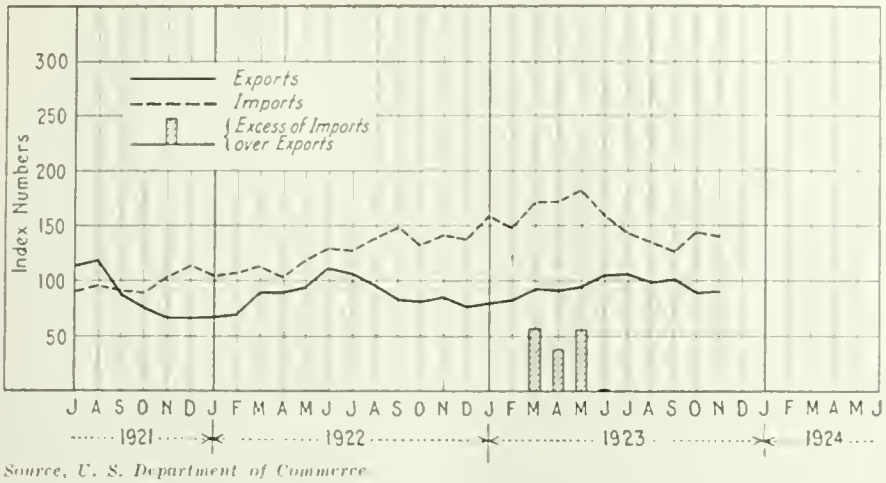
Merchandise imports, Fig. 7, for November were $292,000,000 (a decrease of about 3.5 per cent from October), while exports were $404,000,000 (a gain of less than 1 per cent over October, and the highest figure reached since February 1921). Adjustment for seasonal variation, however, shows that in reality imports declined less than 2 per cent and exports gained only about 1 per cent during the month. One reason for the heavy export total is the recent high price of cotton, that commodity being a large factor in autumnal exports from the United States.

The excess of exports over imports of merchandise for the month of November was $112,000,000, bringing the "favorable balance of trade" for the first eleven months of 1923 to about $249,000,000, against $669,000,000 for the same period last year.

Conclusion. In the foreign trade situation there is no significant change from the month of October. The favorable indication given by the upward trend of imports continues.

New York Stock Exchange

Fig. 8 shows that our forecast for the New York Stock Market has been amply fulfilled. Between the middle of November and the middle of December the average of 50 stocks advanced from 81.57 to 83.56. During the same period the average daily volume of shares traded increased from 924,000 to



Source, U. S. Department of Commerce

FIG. 7 FOREIGN TRADE OF THE UNITED STATES
Corrected for seasonal variation. Average of 1921 = 100.

1,555,000. Although a technical reaction would be logical toward the end of December, a continuation of the general upward trend is likely in January. The chief doubtful factor is the attitude of Congress toward the railways.

Bank Debits and Postal Receipts

Bank Debits. After eliminating seasonal variation, the index of the average weekly debits to individual accounts, Fig. 9, reported by nearly 250 centers, was 124.5 for November as against 114.8 for October. (The average for 1921 = 100). The figure indicates greater activity in November than in any month in the period covered by Fig. 9 except February and April of 1923, and is a reflection of the current revival of trade. The unadjusted index for November registered a gain of about 5 per cent over October 1923, and more than 10 per cent gain over November 1922. Debits for the first week in December, however, were slightly below the average for November.

Postal Receipts. The unadjusted index of postal receipts for 50 selected cities during November showed a loss of 2½ per cent from the October figure. The actual decline, however, was much less than the usual seasonal loss, and the adjusted index therefore shows that postal receipts were 124.1 in November against 122.6 in October. The November index was higher than in any month included in the chart.

Conclusion. These indexes are among the best for showing the trend of business. Their upward movement is of great significance.

Retail Trade

Mail Order Sales. November sales of Montgomery Ward and Sears-Roebuck totaled $34,528,000, as compared with $37,743,000 in October. (See Fig. 10). After adjusting the index for seasonal variation, it is seen that the decrease was greater than the usual seasonal decline. That is, November failed to continue the pace set up in October, and registered a net drop of about 7½ per cent.

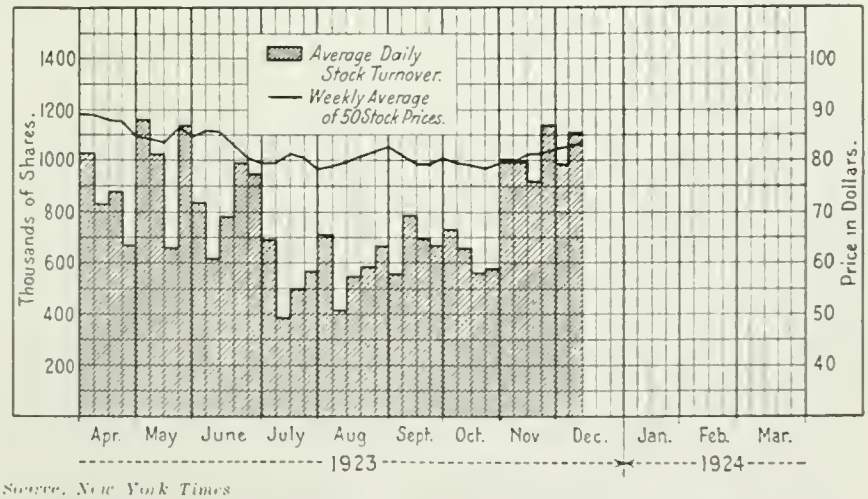
Chain Store Sales. The adjusted index of four chain store systems shows a decline of less than 0.2 per cent from the October figure. This small change leaves the index at a high level.

Conclusion. Without the department store sales index for October (the data for which were not available) it is difficult to draw any definite conclusions as to recent changes in the retail situation. On the basis of the two indexes at hand, there has been a minor recession in retail volume.

Prices and Interest Rate

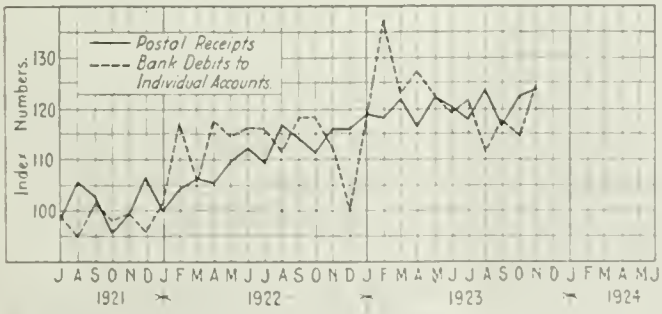
Prices. As appears in Fig. 11, the general trend of prices appears to be upward, while the interest rate is sagging.

Prices, however, are very irregular and are likely to remain so throughout the winter. Some important commodities are very weak, while others are strong. This situation is reflected in the fact that Dun's index as of December 1,



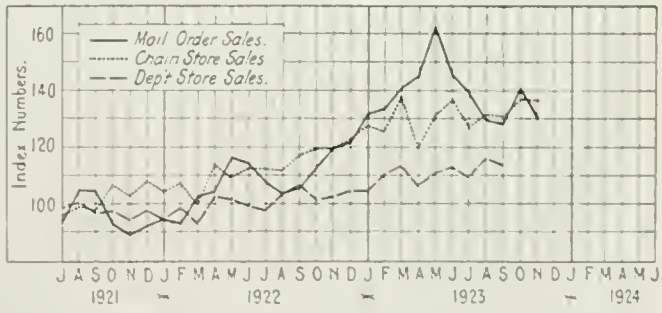
Source, New York Times

FIG. 8 STOCK TURNOVER AND PRICES ON NEW YORK STOCK EXCHANGE FOR 1923


Postal Receipts
Bank Debits to Individual Accounts
Index Numbers.
130
120
110
100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

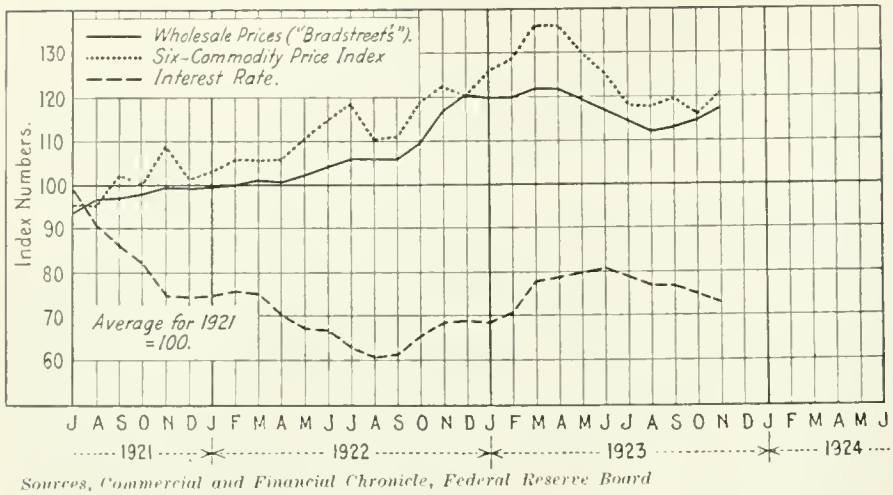
Sources, Federal Reserve Board; Post Office Dept.

FIG. 9 BANK DEBITS AND POSTAL RECEIPTS
Both curves corrected for seasonal variation. Average of 1921 = 100.


Mail Order Sales.
Chain Store Sales
Dept Store Sales.
Index Numbers.
160
140
120
100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Commercial and Financial Chronicle; Federal Reserve Board

FIG. 10 SALES OF MAIL ORDER, CHAIN AND DEPARTMENT STORES
2 mail order houses; 4 chain stores; 306 department stores. Corrected for seasonal variation. Average of 1921 = 100.



Sources, Commercial and Financial Chronicle, Federal Reserve Board

FIG. 11 WHOLESALE PRICES AND INTEREST RATE
Interest rate is the monthly average, corrected for seasonal variation.

declined 0.5 per cent, while Bradstreet's index rose 2.2 per cent, the difference being chiefly due to the greater emphasis laid by one on bread stuffs and by the other on textiles and metals.

Our special 6-commodity index, designed to indicate the general industrial trend in a sensitive way, supports Bradstreet's index. (See Fig. 11).

Apparently the general price level is considerably above the low point of the year, but is a little lower than it was a year ago at this time.

It is probable that the general trend of prices will continue upward for several months. The P/Y line, which is an index of demand, usually forecasts the trend of prices and its present course is upward. This conclusion continues to be substantiated by the abundant supply of money and credit, which tend toward higher prices.

Interest Rate. The interest rate on commercial paper continues to show an easier tendency. During November the rate on prime paper was 5 per cent, in spite of the seasonal demand which usually comes at this time. When seasonal variation is eliminated, therefore, the interest rate curve declines.

The trend of wholesale prices usually forecasts the interest rate by about five months. It is, therefore, *probable that an upward trend will appear in interest rates in January or February 1924.*

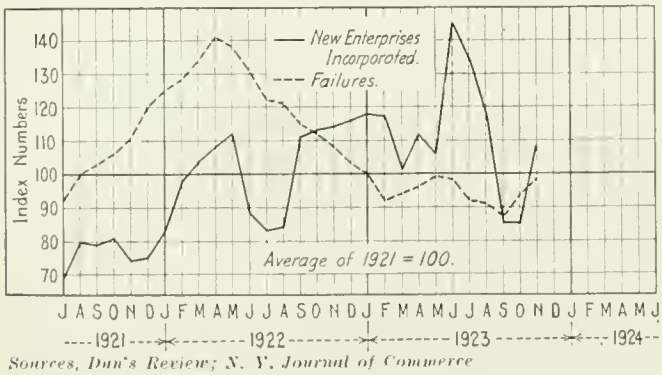
Failures and New Business Enterprises

Fig. 12 continues to reflect the mixed situation which exists in the business world, since it shows that new enterprises are increasing in volume, while at the same time the number of business failures has also increased.

New Enterprises. The chart shows a marked increase in new enterprises. The November index, after eliminating for seasonal variation, was 126.1 compared with 105.1 in October and 125 in November 1922. (Chart shows averaged data).

Failures. Ordinarily business failures are slightly fewer in November than in October. This year, however, failures increased in number in November with the result that our adjusted index rose considerably. (See Fig. 12).

Conclusion. Increase in new business enterprises shows greater optimism and hopefulness for the future. The increase in business failures reflects the present unsettled conditions and indicates that the upward turn which is to be expected in the spring has hardly begun yet. Failures, however, usually lag somewhat behind in the business cycle and a decrease in their number is to be expected soon.



Sources, Dun's Review; N. Y. Journal of Commerce

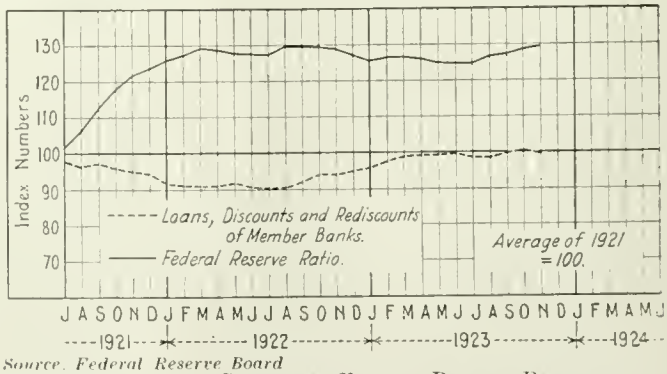
FIG. 12 BUSINESS FAILURES AND NEW ENTERPRISES
Adjusted for seasonal variation; 3 months' moving average.

Bank Credit

Loans and Discounts. Total loans and discounts of the 767 reporting member banks of the federal reserve system were $11,903,987,000 on November 28. This is a loss of less than 0.3 of 1 per cent from the previous month, a gain of 6 per cent over November last year, and is the highest figure reached since May 1921, with the exception of October 1923. (See Fig. 13).

Federal Reserve Ratio. After correction for seasonal variation, the November index of the ratio of reserves to deposit and federal reserve note liabilities combined increased to 129.1 from 128.3 for October. This is the highest point it has ever reached, with the exception of August and September, 1922.

Conclusion. The recent slight changes in these indexes have little significance, in view of their high levels. Loans and discounts continue to reflect greater activity in business than existed at this time last year and some recovery from the slump of July and August.


Index Numbers
130
120
110
100
90
80
70
Loans, Discounts and Rediscounts of Member Banks.
Federal Reserve Ratio.
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Source, Federal Reserve Board

FIG. 13 BANK CREDIT AND FEDERAL RESERVE RATIO
Federal reserve ratio is ratio of total reserves to note and deposit liabilities and has been corrected for seasonal variation.

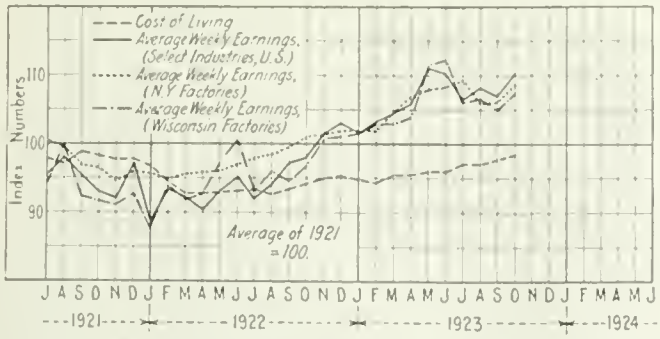
Wage and Employment Situation

Employment Down: Earnings Up

Earnings and Cost of Living

Fig. 14 shows the trend of average weekly earnings and of the cost of living. All of the curves moved up in October.

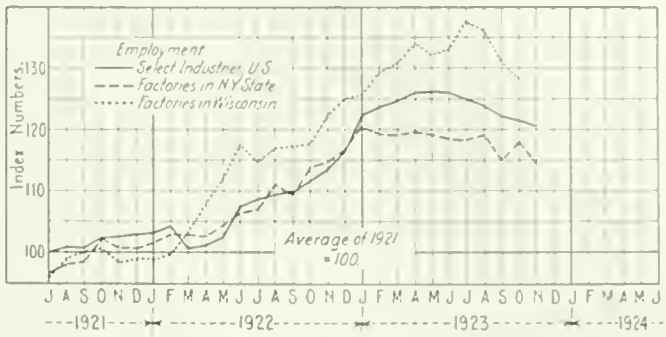
New York Earnings. The seasonally adjusted index increased 2.8 points reaching 108.9 in October, the average


Cost of Living
Average Weekly Earnings, (Select Industries, U.S.)
Average Weekly Earnings, (N.Y. Factories)
Average Weekly Earnings, (Wisconsin Factories)
Index Numbers
110
100
90
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, U. S. Bureau of Labor Statistics; N. Y. State Dep't of Labor; National Industrial Conference Board

FIG. 14 WAGES AND COST OF LIVING

New York and Wisconsin factories curves corrected for seasonal variation.


Employment
Select Industries, U.S.
Factories in N.Y. State
Factories in Wisconsin
Index Numbers
130
120
110
100
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, U. S. Bureau of Labor Statistics; N. Y. State Dep't of Labor

FIG. 15 THE TREND OF EMPLOYMENT

Corrected for seasonal variation.

for 1921 being 100. This is the highest point since 1920, excepting only July 1923.

The most important cause of the gain was increased earnings of those engaged in the clothing industries in New York City. Overtime work in preparation for the Christmas trade was the chief factor.

Wisconsin Earnings. In October the seasonally corrected index of wage-earnings in Wisconsin advanced 1.5 per cent, and except for May and June of this year attained the highest point since January 1921. There were increases of average weekly earnings in most of the manufacturing industries. In the mining and construction industries, however, earnings were less in the month ending October 15 than in the preceding month.

Selected Industries in the United States. This curve, which is not corrected for seasonal variation, went up about 3 per cent in October. Except for May and June of 1923, the index is at the highest point since 1920. Increases of weekly earnings were reported in nearly all industries. An analysis of per capita earnings in ten leading industries appears in Fig. 16.

Cost of Living. The cost of living index based on the average of 1921 as 100 stood at 98.3 in October, which is the highest in two years. Increases occurred in the prices of food, clothing, and fuel and light.

Conclusion. The trend of weekly earnings, which has been downward for the past few months, was reversed in October. Also, it is significant that the increase in cost of living failed to keep pace with the increase in earnings. The purchasing power of labor is now on the upgrade again.

The Employment Trend

New York State. After a rise in October, the adjusted index of employment receded again in November, as shown in Fig. 15. There was an actual decrease of almost 2 per cent in the number employed, although normally November is the busier month. The most marked decrease was in the clothing industries, especially in men's and women's outer garment factories where the decrease at the end of the busy season was greater than usual.

Wisconsin. November figures are not yet available, but employment declined in October for the third consecutive month. Nevertheless, it still stands at 28 per cent above the average of 1921. Relatively small decreases occurring in a large number of industries overcame large gains of employment in lead and zinc mining, and building construction. A decrease of 46.5 per cent in canning and preserving was undoubtedly seasonal.

United States. The seasonally adjusted index of employment in the United States as of November 30 is about 1 per cent lower than it was the previous month. The actual decrease of the total number employed was 0.5 of 1 per cent, but normally there is an increase of 0.5 of 1 per cent in November.

The decline is reported to be due mainly to temporary curtailments of employment in railway centers, and in the iron and steel industry.

Conclusion. Employment shows a slight but definite downward tendency. However, it is well above the levels of 1921 and 1922 and probably will continue at a high rate for several months.

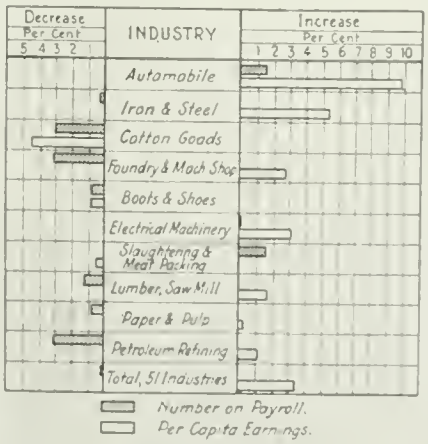


FIG. 16 TREND OF EMPLOYMENT AND EARNINGS, OCTOBER 1923

Employment and Earnings in Selected Industries

The trend of employment and earnings in the ten leading industries of the United States is shown graphically in Fig. 16.

Employment. During October there was a decline in the number on the payroll in most industries. This was especially striking in the ten leading industries. In these, decreases of 3 per cent, or slightly more, were noted in cotton goods manufacturing, foundry and machine shops, and petroleum refining. Smaller decreases occurred in the iron and steel, boots and shoes, saw mill, and paper and pulp industries. There was a slight increase in the number employed in electrical machinery manufacturing, and increases of 1.5 per cent occurred in both the automobile and slaughtering and meat packing industries.

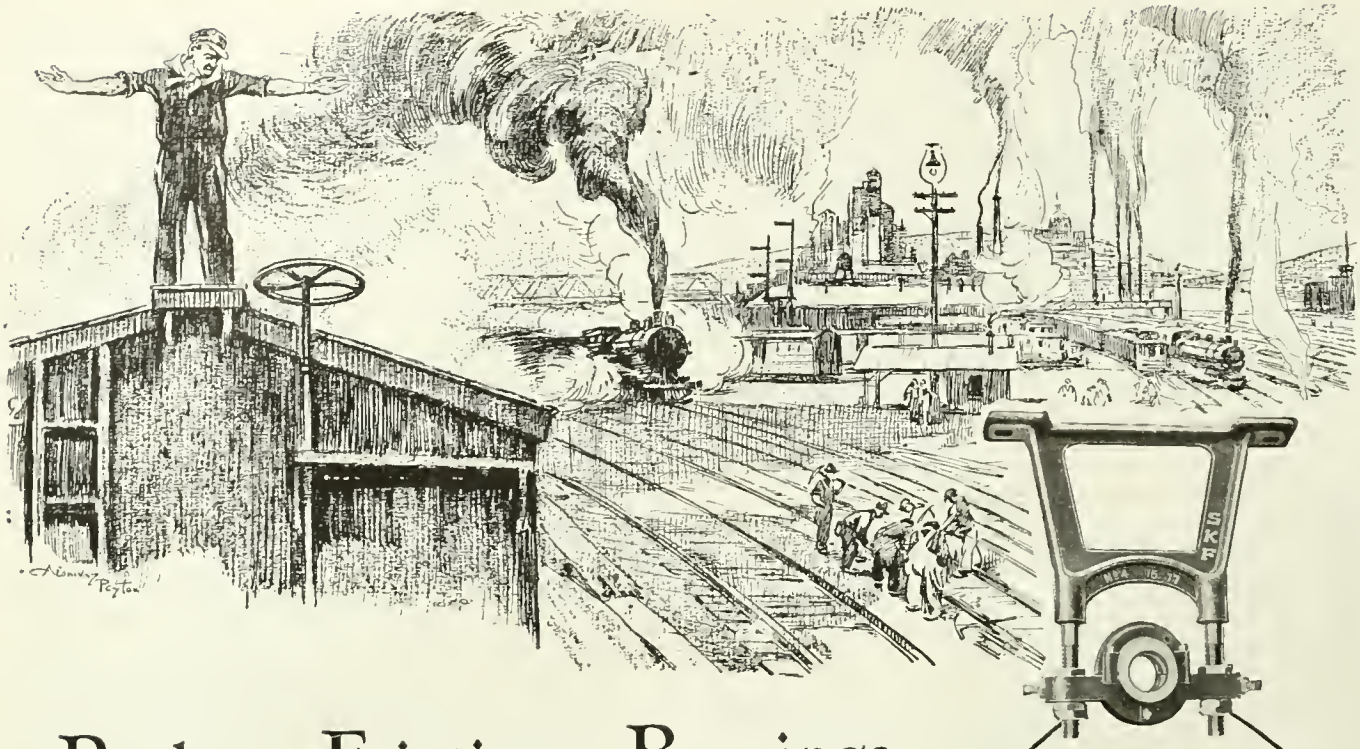
Per Capita Earnings. Although the number of factory workers employed was smaller during October, the trend of per capita earnings was up. In the automobile industry the increase amounted to 9.8 per cent, and in the iron and steel industry earnings rose 5.3 per cent. For the average of 51 industries in the United States the increase in per capita earnings was 3.4 per cent. In only three of the industries analyzed in Fig. 16 were there declines. These were cotton goods manufacturing (4.5 per cent), boots and shoes (0.9 per cent), and slaughtering and meat packing (0.5 per cent).

Immigration and Emigration

The latest available figures on immigration are for September. *Immigration continued to increase, and emigration again decreased.*

The figures are:

	August	*September*
Immigrants	88,286	89,431
Emigrants	6,489	6,073
Net gain	81,797	83,358



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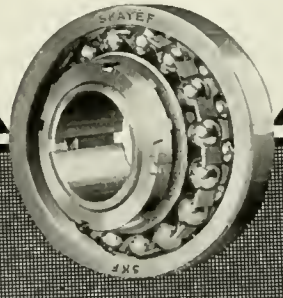

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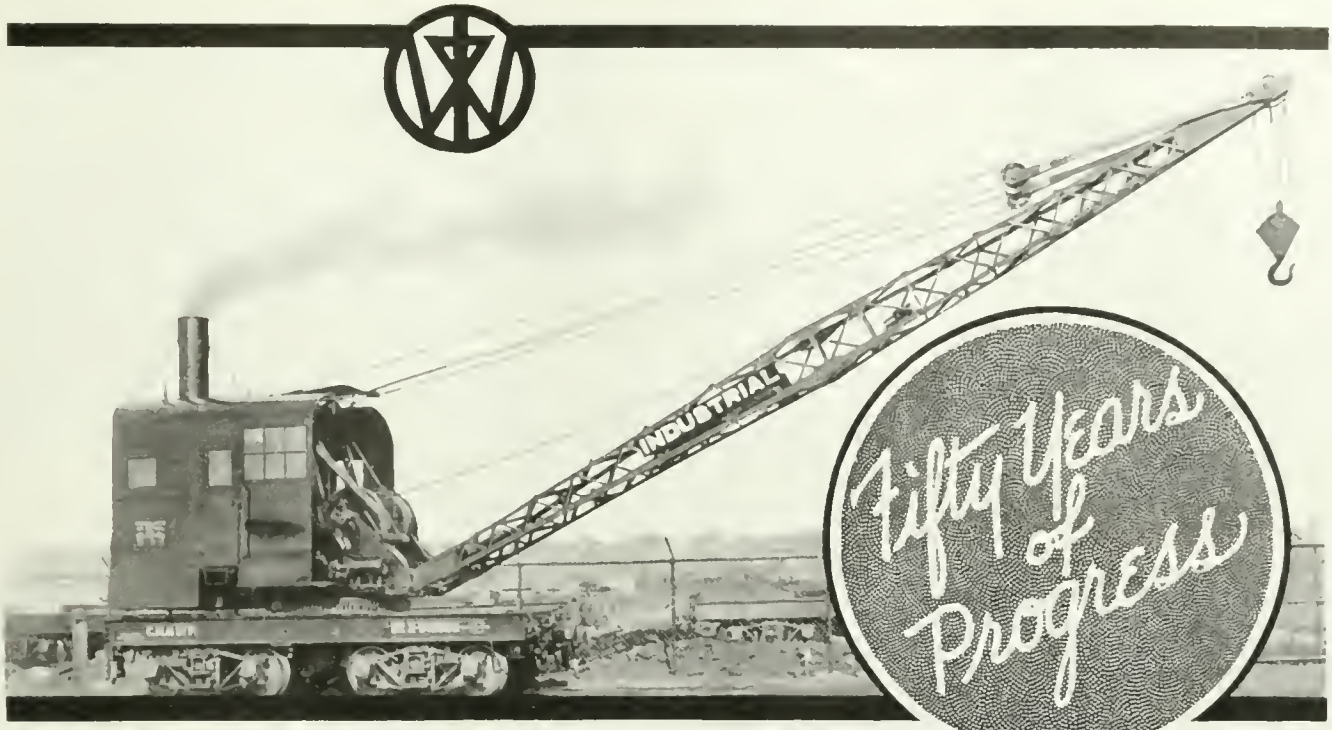

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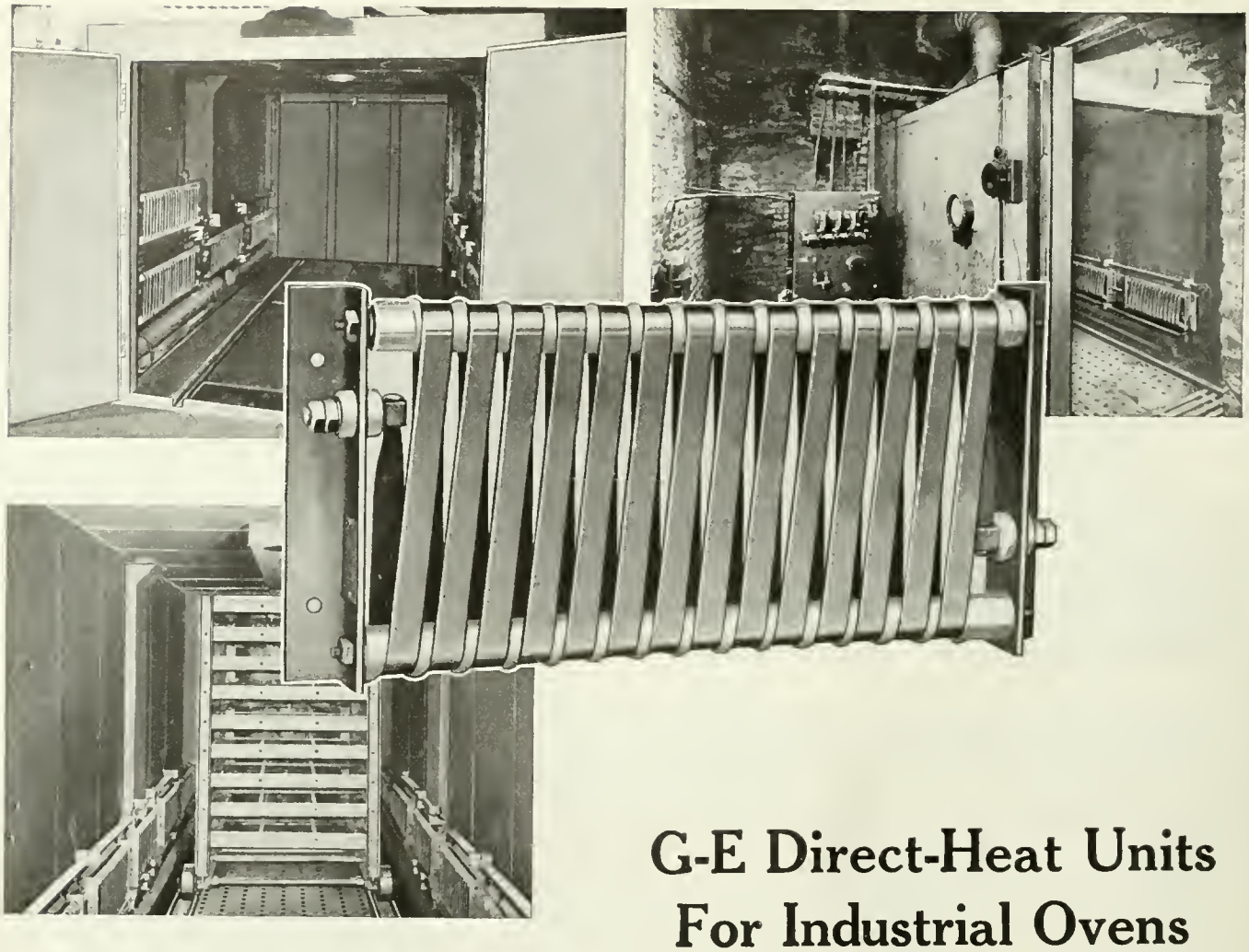

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GENERAL ELECTRIC

MANAGEMENT AND ADMINISTRATION

VOLUME VII JANUARY, 1924 NUMBER 1

Industrial Research a Factor in Progress

By ANDREW W. MELLON

Secretary of the Treasury, Washington, D. C.

Index Number

6(072) Industrial Research

THE edifice of industrial research has been reared upon the basis of science. In its laboratories may be seen the achievements of over a century of sound methods of investigation—various and complicated applications of science to industry, by which human life has been profoundly affected.

Andrew W. Mellon

Science provides the procedures for interpreting the operations of nature and industry; and hence the employment of scientific methods enables the explanation and application of chemical and physical processes. The scientist is always interested in the manner in which these interpretations, explanations, and applications are made. If he is engaged in purely scientific investigation, he perceives facts of theoretical significance; if he is conducting industrial research, he recognizes and utilizes observations of practical importance in manufacturing. But the average business man or industrialist does not see, or cares little, for these elements; what is of interest to him is the product, process, or machine which has been devised, explained, and then developed to commercial applicability, not the methods of explanation and development. A discovery of a laboratory must bring a message of value to the business or manufacturing world.

Industrial research has had an essential part in the evolution and development of manufacturing practice. In fact, there is abundant evidence that it facilitates industrial progress and that an industry is made great, not by its raw materials, not by its products, but by the men who show how to use them to best advantage, i. e., by scientists and engineers in its service. All leading branches of manufacture, whether physical or chemical, bear the impress of extensive research, which has not only found new materials and novel processes for their betterment but has also advanced their plant practice by the application of scientific methods. The noted inventions in technology as well as the modern wonders of science—spectrum analysis, telephone, antiseptics and antitoxins, x-rays, radium, airplane, and wireless telegraphy—have all resulted from the investigations of skilful experimentalists.

The highly beneficial influence of industrial research in so many instances has induced economists to maintain that industry could not subsist without it. Numerous manufacturers have a similarly high appreciation of the value of industrial research—a sympathetic attitude which may be illustrated by a passing survey of the development through scientific investigation of several important branches of industry.

The bringing of aluminum into the rank of the common metals by Charles M. Hall, a chemist, is regarded generally as one of the foremost research achievements of the nineteenth century. In fact, the historian of technology classes the industrial production of aluminum alongside the invention of Bessemer steel. The commercial development of the Hall process was begun in 1888, and the manufacture of aluminum became an established industry in the early nineties.

Since then the progress has been rapid, and chemistry has been the pathfinder.

A number of the early problems, especially the working out of an industrially satisfactory procedure and apparatus for obtaining the metal from its oxide, alumina, by the aid of the electrical current, and the creation of commercial applications for the new product, presented very serious difficulties, in view of the limited research facilities then available. However, these fundamental problems were solved gradually by Hall and his associates in the Pittsburgh Reduction Company, although many other important discoveries and improvements have been made in more recent years by the large research organization of the Aluminum Company of America.

A great deal of time was required in commercializing aluminum, but Hall persisted in his experimental work and finally succeeded in perfecting a valuable discovery. This case shows that it is when speculation has been reduced to practice, when research has resulted in discovery, and when that discovery has been completed by continued investigation and development —when some new compound, art, manufacture, or machine has been thus produced which is of public utility—that the public becomes benefited.

Chemistry in the Iron and Steel Industries

The iron blast-furnace is merely the chemist's crucible on a gigantic scale, operated on chemical principles; and the application of chemistry to iron smelting has brought about such wonderful transformations that now the chemist occupies the foreground in directing the operations in the industry.

In describing the many difficulties encountered during the early operation of the Lucy furnace at 51st Street, Pittsburgh, Andrew Carnegie, the great ironmaster, says in his autobiography, that the undertaking "would have been postponed if we had realized its magnitude". Little furnaces could be run by rule-of-thumb and guess, but not such a monster as the Lucy. Finally he employed a chemist to assist the manager, and straightway—"Lucy furnace became the most profitable branch of our business, because we had almost the entire monopoly of scientific management. It was years after we had taken chemistry to guide us that it was said by the proprietors of some other furnaces that they could not afford to employ a chemist. Had they known the truth then, they would have known that they could not afford to be without one."

It is difficult to recall a more far-reaching invention than that of the dry air-blast in the manufacture of iron, devised by James Gayley, a metallurgical chemist. This discovery resulted in a reduction of from $0.50 to $1 per ton in the cost of producing pig iron, besides making it possible for the ironmaster to produce, in all weathers, a metal of uniform quality. The dry air-blast was developed by Gayley between 1885 and 1904 at the Edgar Thomson and Isabella furnaces in Pittsburgh.

Research looking toward improvements in the composition and manufacture of tool and cutlery steels, and the development of better processes of heat treatment, has had and is enacting a most essential rôle in the success of the entire steel-products industry.

Manufacturers of coal-coking plants and equipment are making constant use of research methods in keeping pace with the progress of the iron and steel industries, which are the principal consumers of coke. The types of coking ovens in which by-products (gas, ammonia, coal tar, benzol, etc.) are saved as well as by-product coking practice in general have been worked out through scientific investigation, and research laboratories are maintained for the purpose of effecting greater economies through improvements in apparatus and operation.

For a number of years the introduction of by-product coke-making was slow, being retarded by certain imperfections of construction and by the deep-rooted prejudice of blast-furnace men against by-product coke. In 1908, however, the industry received a marked impetus as the result of the activities of the United States Steel Corporation, which, after an exhaustive study of various European types of ovens and by-product apparatus, selected the Koppers design, a development of extensive research, and built a 280-oven plant of this type in Joliet, Illinois. This plant was successful beyond all expectations, and was followed rapidly by the erection of large plants using the Koppers process, at Gary, Indiana; Fairfield, Alabama; and Duluth, Minnesota. The World War caused an enormous increase in the construction of by-product ovens, and at present it would seem that at the close of another decade little should remain of beehive coke manufacture.

By participating actively in building up a great by-product coke industry in the United States, the research chemist and engineer have benefited other branches of manufacture in various ways. They have made available fuel gas for domestic and industrial consumption, sulfate of ammonia for use as a fertilizer in agriculture, coal tar for the production of dyestuffs and of important chemicals for use in medicine, benzol, an engine fuel, industrial solvent, and valuable raw material for the manufacture of chemicals, and toluol, the source of "TNT," a well-known high explosive, and other chemical products.

Some General Effects of Industrial Research

The collateral effects of research conducted for a specific industry are most noticeable where manufactured products have been improved, or utilizable by-products have been made available to different industries. Among others, the heavy chemical, pharmaceutical, and petroleum industries have profited by giving investigational attention not only to perfection of their processes and products, but also to finding uses for their by-products and waste materials. In this way they have aided in the development of various other branches of manufacture.

The recognition of the realizable economic value of industrial research, on the part of educators as well as prominent manufacturers, has led to the establishment of relations of co-operation among various educational institutions and industries. In addition to benefiting manufacturers by the systematic study of problems, which from their nature can best be attacked

in university laboratories, these institutions are training young men for technical service with the requirements of the industries in mind. Such an arrangement stimulates sound preparation for useful work as well as productive research on behalf of the industries.

The industrial fellowship system in operation since 1911 in the University of Pittsburgh is one method of rendering service of this character. At this institution is an industrial experiment station which accepts for investigation manufacturing problems requiring a long period of time for their solution. Each problem studied is different from all others under investigation and is of sufficient scope to warrant the service of at least one research man for a minimum period of one year. Each research is conducted at cost and all results obtained belong to the company which sustains the work.

The effects of the influence of scientific investigation are so far-reaching and generally beneficial that they are interwoven intimately with everyday life and constitute the basis of human progress. Industrial research is the great gift of science to manufacturing.

Developing the Statistical Department

By HARRY DEAN GIDNEY

Statistician, Pacific Telegraph and Telephone Company

Index Number
658.16 Statistical department
658.53 Graphic charts

PRIOR to our involvement in the World War in 1917, the average business man thought of statistics mainly in connection with governmental reports on population, marriage, divorce, immigration, imports and exports. Since that time the terms "statistics," "statistical department," and "statistician," have become familiar to all readers of business and financial papers. Also publishers' lists are beginning to show a fair percentage of titles, such as—"Business Forecasting," "Statistical Methods," and "Graphic Charts in Business".

During the war it was necessary to compile a vast amount of statistics on manufactures, crops, traffic, labor, transportation facilities, and supplies, and it was found that much of the data gathered could be presented graphically in such fashion as to save a great deal of time for the officials using these statistics. The result was that after the war a large number of men, imbued with the idea of using statistics and graphics in business, were loosed on the business world. The idea took hold and where previously only a few firms had made any notable progress in business statistics today hundreds of firms have their own statistical department, and many more are preparing to follow the same course in the near future.

Before making any suggestions for the development of the statistical department it may be well to consider the advisability of maintaining any such department in the business organization. In the past, business men have succeeded, and failed, without the aid of anything except the records supplied by their bookkeepers and their own common sense. Why can they not still work along the same lines and obtain the same results without going to the expense of a statistical force?

The answer is, that during the past few years the scale of doing business has so increased that it is almost impossible for the executive to keep in touch with the work and results of his organization through personal contact. The number of hundred thousand, million, and billion dollar corporations has increased rapidly of late years and in all probability will increase even faster in the future. With the increase in the scale of doing business usually comes a lower unit production cost, due to the many factors of efficiency in production, purchasing and sales methods then available. Goods are produced in quantities which make a small unit margin of profit possible. Competition is keen and cost of placing the goods of any business on the market must be kept at the minimum if the business would live. Any mistake in the present operation or forecast of the future is likely to prove costly. Therefore, notwithstanding the difficulty, it is even more important now than it was when business organizations were smaller that the executive be well informed on the various phases of his business and also on the social, business, and financial conditions of the territory in which he operates. Also he must be informed on the condition of the country as a whole, in order that he may intelligently formulate the policies and direct the operations of the business.

It is to supply the executive with such necessary information in a shape which will permit of comprehension with the minimum of effort, that the statistical department has been brought into existence. The accounting department furnishes cold figures regarding the operations of the business. Various business and financial papers furnish information on business conditions of the country. It remains for the statistical department to take this information and analyze and combine it into comparisons of present, past, and normal, and forecasts of the future.

The position of the statistical department in the organization varies. As most of the basic data with which it works is compiled and located in the accounting department, its proper place is, as a rule, under the chief accounting official. However, it may be found that on account of the personality of the heads of departments, better results will be obtained if the statistician reports directly to the president or vice-president in charge of operations. It is usually much more simple to diffuse helpful information from the top down through the organization, than from the bottom up through the same organization.

In planning the statistical department its work may be divided as follows:

1. Analyzing records of the accounting department to show what has happened or what is happening, and when and why it happened, and who or what is responsible.
2. Collecting, analyzing, and issuing information on business, financial, or social matters which will be of assistance to the executive in the administration of his work.
3. Projecting probable future results from studies of operating results, business, financial, and social conditions and business cycles.

Analyzing the Accounting Records

The accounting department is the repository of a large amount of data but its accounts are, in a way, impersonal. They record facts and exhibit results without showing, except upon extensive study, the causes underlying the results. Under the first division named above, it is for the statistical department to study these accounts, analyzing the underlying causes and presenting in graphical form the information obtained by these studies.

To begin with, it would be well to prepare a set of monthly control charts for the executive, presenting the results as shown by the books over a period of two or three years. If these charts are prepared in a size to fit a pocket-size binder they will be used more by the owner, as it is then possible to carry them around for ready reference.

Various items of revenue, expense, turnover, etc., may be plotted in a manner which will show at a glance the results of the month compared with any other month, or the results for one year compared with the results for another year. Comparisons of operating ratios and averages may be determined from these charts, whereas it would take much research and figuring to get the same results from the operating and financial reports.

In some instances, the seasonal variation and long-time trend should be eliminated from the figures shown on the charts. After this elimination, the chart will show whether the results for any month are above or below normal, a thing which cannot always be ascertained by looking at the accounts.

The field of cost accounting is especially adapted to the use of graphics. Efficiency of employees, machines, and processes may be charted in a manner which will inform the executive without any elaborate study whether or not the proper standard of efficiency is being attained.

Another part of the work under the first division which will be found to be of great value, is the preparation of reference charts. These charts record graphically the financial and operating results for a long period of years, and show long-time trends.

It will be found in most cases that the early use of graphics will assist greatly in developing the statistical department. The executive is not, in all cases, in harmony with the use of statistics, and it is only after selling him the idea that the best progress can be made. Graphics catch the attention and after a short acquaintance with them the skeptic is very apt to become an enthusiast. And it is not until the executive becomes interested enough to ask for information and studies, that the statistical department will begin to function as it should.

The second division of statistical work deals largely with data outside the immediate business. It is necessary for the executive, in addition to his knowledge of the business, to keep in touch with the course of other businesses, the social conditions, the business cycle, and agricultural conditions. This information is present in scattered form in daily papers, business and financial journals, technical magazines, and in numerous reports of private and public institutions. The executive, if he had time, could get the results by reading all of these, but there are few executives who can do this without neglecting the immediate administration of their positions. It is necessary, therefore, that the statistical department collect, analyze, and summarize this data for the use of the executive.

To carry out this work, a flow of periodic reports, magazines, journals, and newspapers should be set in motion. From these at short periods, should be issued a condensed summary of such data as is valuable to the executive, eliminating anything which would waste his time. The summary can be largely graphical, with a small amount of written explanation and figures, showing the trend of conditions without the expenditure of too much time in study. This sort of report, after it is once started, is very easily maintained.

Forecasting Responsibilities

The third division of work is the most complicated and also probably offers more opportunity for benefiting the business than any other part of the work. The statistician should, from the accounting department data, project into the future the course of items of expense, revenue, and other operating data. From a study of the data accumulated on business conditions these projections should be adjusted to provide a forecast as to the future trend of each item. These forecasts can be made for a considerable period, being corrected each year as the new data are accumulated. It will be found that they are very accurate for the first year and much more accurate than any ordinary rule-of-thumb forecast for many years into the future. It will be found that this branch of the statistician's work will improve greatly with time, as experience will enable the development of greater and greater accuracy in reading business cycle signs and determining long-time trends.

In closing, a warning should be sounded in regard to the furnishing of graphic charts and reports. A person working with graphics will often become so enthusiastic that he will turn out charts in the same manner as the presses turn out German marks. And the majority of the charts will be of about as much value to the executive as the mark. Care should be taken that the basic data is correct and that the chart will be of real use to the executive, and also that the cost of producing the chart is not more than the value to the executive. Attention to this warning will result in weeding out a great many of what appears at first thought to be very valuable charts.

Mobilization of Cash Reserves

"Tuning Up General Motors"—Article One

By ALFRED H. SWAYNE

Vice-President, General Motors Corporation

Index Number
658.14 Financial control
658.9:629.113 Automobile industry. Management

IN order to furnish a background, and to indicate the magnitude and the complexity of our problem of working capital, it will be necessary to refer briefly to the units which have been brought together in the General Motors organization. On October 13, 1916, General Motors Corporation was incorporated in Delaware to succeed a company of similar name organized in New Jersey in 1908 as a holding concern for the capital stock of the companies which were then manufacturing the Buick, Cadillac, Oakland, Oldsmobile, and GMC Truck. Today General Motors corporation is primarily an operating concern, owning the plants, properties, and other physical assets of nearly all of its manufacturing divisions. The corporation also owns a large part, or all, of the capital stock of a number of companies directly connected with its activities.

GENERAL MOTORS BUILDING, DETROIT

In addition to the Buick, Cadillac, Chevrolet, Oakland, Oldsmobile, and GMC Truck, the manufacturing divisions in the General Motors group make these nationally advertised, trade-marked products: Fisher bodies; Delco-light and power plants; Frigidaire; Hyatt roller bearings; New Departure ball bearings; Klaxon horns; Harrison radiators; Delco and Remy starting, lighting, and ignition systems; Jaxon rims; AC spark plugs.

Geographically, the manufacturing plants are distributed as follows: California, two cities; Connecticut, three; Illinois, one; Indiana, two; Missouri, one; Michigan, seven; New Jersey, three; New York, four; Ohio, three; Pennsylvania, two; Texas, one; Wisconsin, two; Canada (Province of Ontario), two. Under the supervision of the General Motors Export Company and General Motors, Ltd., of Great Britain, which cover the world with their selling organization, General Motors is carefully developing extensive markets for motor cars overseas.

One more factor, the financial scope of the organization, should be added in order to complete the picture. The total assets of the Corporation at June 30, 1923, amounted to $564,273,176. The excess of current assets over current liabilities (net working capital) June 30, 1923, was $150,196,212; cash in banks on that date $56,055,248; sight drafts $10,220,439; notes and accounts receivable $23,362,226; inventories $114,725,627. Current liabilities the same date included accounts payable, $30,657,255; taxes, payrolls, etc., $22,623,448; federal taxes payable during 1923, $780,193; and accrued dividends $1,139,644.

Under the management which prevailed before the du Pont interest in General Motors was established, each of the many operating divisions handled its own cash. A unit in Michigan might have on deposit in local banks much more than it needed, and drawing little or no interest. At the same time another unit in New Jersey or Texas might be under the necessity of borrowing large amounts, handicapped by heavy local demand for banking accommodation. The remedy for this condition appeared to be the transfer of inactive balances to some central reservoir which might be tapped for the benefit of any unit, the minute its need of working capital was made known. To establish such a reservoir, and to provide a system whereby funds not needed immediately by the units might flow easily and quickly from them into it, was the corporation's problem.

To devise the method was not the easiest task in the world. In addition it was necessary to make the plan thoroughly acceptable to all the units. The fiscal officer of a unit having large inactive deposits was not

keen to transfer them to the general organization. Admitting that he did not need the cash at the moment, he still argued that he was certain to require the use of it in two, or four, or six months, and he wanted to be absolutely certain of having it when the time of necessity arrived. Just how this argument was met and how the fiscal officers were won over to the plan will be indicated later in this article.

In addition to this rigidity of cash there was another serious problem—the settlement of interplant transactions. Formerly payments were made by check, forwarded through the mails. If Cadillac owed Hyatt for materials furnished, a check was drawn in Detroit and mailed to Newark. Hyatt deposited the check in its local account. Clearance took additional time, and, as a result, four or five days were consumed on each check transaction. More accurately four or five days were wasted, to say nothing of the added expense of accounting and other services in handling the transactions.

The method of releasing for use as general working capital the cash heretofore tied up in a staggering amount of "float" may be stated in a single sentence. There were established central reservoirs and a system for handling the cash deposits of all units by telegraph. In place of slow remittances by mail there were substituted telegraphic transfers of funds.

How Cash Was Made More Fluid

The sales companies deposit in local banks, which are instructed to co-operate in an automatic system of remittances to the Treasurer of General Motors Corporation. A fixed minimum and maximum are determined for each local deposit account, and when the deposits rise above the fixed maximum the excess above the fixed minimum is transferred by the bank to New York through the Federal Reserve Bank, which has what is probably the finest private telegraph system in the world. These transferred amounts are then credited to General Motors at one of the dozen New York and Detroit banks in which the Corporation maintains deposit accounts.

By telephone or telegraph the Treasurer is notified by the banks of each new credit item. His next act may be to transfer through correspondent banks by the federal reserve telegraph system the whole or any part of the credit to banks in any of the 33 cities in which there are plants having disbursing accounts. For example, deposits at Atlanta may go above the stated maximum at 10 o'clock in the forenoon. In two or three hours the transferred amount may be available for a manufacturing subsidiary in Detroit, Lansing, or Flint, to check against.

As many observers have noted, the service thus rendered the 71 divisions and subdivisions resembles very closely that performed by the federal reserve system for the national banks of the country.

Just as the mails were abandoned for the telegraph to make the cash fluid, the settlement of interplant balances by check through the mails was discontinued in favor of a credit slip system. The devious journey of the check from Cadillac in Detroit to Hyatt in Newark, and thence to other points East or West, was described above. Today, Cadillac pays Hyatt for bearings with a white slip. Hyatt bills Cadillac; Cadillac acknowledges to Hyatt on a white slip; Hyatt mails the slip to the comptroller, who charges Cadillac and credits Hyatt and thus the settlement is made without the use of cash.

In this way intercompany remittances have been reduced to the absolute minimum. Savings have been made in clerical labor and an appreciable reduction of funds in transit has been effected. Raw materials still may pass through several units of General Motors before they are finally taken away from one of the sales units in the form of a finished car. But no longer do the units pay each other in cash or funds for parts or materials purchased. The simple little "white slip" has fortunately changed all that.

Results of These Changes

It is perhaps not too much to say that the internal financial system of General Motors Corporation has been made over. Deposits are properly utilized as a basis of bank credit. There is control of the geographic distribution of both deposits and borrowings, taking full advantage of changes in local industrial and credit factors. At any time it is possible to prepare financial statements that are rarely more than a day behind actual conditions. By the reduction of funds in transit, practically to the disappearing point, large savings in interest have been made. Most important of all, working capital is available almost instantly to meet the needs of the manufacturing branches, so that these are relieved of all concern over financing problems, and of the necessity of holding idle funds in banks against future requirements.

As pointed out recently by a writer in *The Wall Street Journal*, General Motors Corporation functions, in a sense, as a sort of nation-wide reserve board, adjusting its minimum and maximum lines of deposit in local banks according to the fluctuating local pressure for funds. It likewise adjusts its bank borrowings to the regional availability of funds, when it is borrowing at all. During the second half of 1922 General Motors carried no bank loans whatever, but it has mobilized its cash in such a way that it has large potential borrowing capacity.

Selling the Idea to the Units

How were the fiscal officers of the various units won over to the central reservoir plan? The problem was strikingly similar to that of the federal reserve system with the national banks. In order to establish the new method, it was essential to transform the energy of keen individualism or local spirit, particularly among the largest manufacturing units, into a genuine interest in General Motors as a whole, forfeiting as little as possible of the spirit of enterprise and the sense of responsibility manifested by the individual executives.

One of the most important factors in this was the establishment of a monthly ranking of all units on the basis of percentage earned on capital employed. Formerly, pecuniary necessity had served as the chief spur to increased efficiency. To this was added the

rating plan, under which a plant executive knew that the smaller the amount of cash employed in his operation, the higher would be the percentage return on the employed capital. This system plus the definite assurance that cash needs would always be covered by the parent company, offered inducements to division managers to give up their surplus funds to the common pool. However, the controlling factor was the desire of the division managers to help place General Motors on a more efficient basis through the more economical use of its cash resources.

Interest and Banking Relations

Under the former system there was a definite policy concerning interest on bank balances. Certain accounts received interest, but at varying rates; others may have received no interest. All "free balances" have now been eliminated, as well as all arrangements differing from one standard interest rate. Obviously it would be possible for the corporation to obtain a higher rate at certain times and in certain places, but the standard rate was decided upon for reasons entirely logical.

General Motors regards its banks and bankers as being in a very definite sense partners in its business. Instead of investing inactive funds in securities, General Motors leaves them on deposit at a reasonable interest rate, supporting its lines of credit. Should the corporation need to borrow at any time, funds are ready. Meanwhile the bankers have been able to make good use of the corporation's deposits, and are naturally pleased with the arrangement.

Desirable balances for the various bank accounts are worked out primarily on the basis of the lines of credit granted the corporation, the ordinary ratio being a credit line of five times the average balance carried. The balances in the collection accounts correspond roughly to the "good money"—that is, the actual collections, over a period of three days. These banks remit collected funds twice a week, wiring even thousands only.

Savings in Interest

Interest formerly lost on funds in transit was a big item in itself. The new, practically instantaneous method of transfer enables General Motors to earn interest on substantially every dollar *somewhere*. The interest, to be sure, is at a comparatively low rate, but the aggregate is considerable and it should be remembered that the corporation uses its balances primarily to support lines of credit, and to secure the fullest possible co-operation of its friends the bankers, rather than to produce large amounts in the form of interest. As a matter of fact, the corporation receives big dividends in peace of mind under this plan, for so long as the banker has a comfortable feeling about his deposits, the corporation can have the same kind of feeling about its ability to borrow if funds are needed.

It is most important, of course, for the corporation to know exactly where its cash is at a given time, so a daily statement of cash *by banks* is prepared. The average total is in the neighborhood of $40,000,000. This seems, at first thought, to be a very large amount, but it must be remembered that it is equivalent to less than one month's business of the corporation, in the light of which it does not appear excessive.

It would be manifestly unfair to end this account of the internal financial co-ordination of General Motors without testifying to the literally indispensable aid of the federal reserve system through correspondent banks. That these transformations could have been accomplished without its help is perhaps possible, but scarcely probable. General Motors seems to have made as much use of the machinery of the system as has any large corporation in the country.

The federal reserve service is, thanks to the remarkable telegraph service already referred to, practically instantaneous. As is by no means universally the case, (since certain western banks make a substantial charge for transfer), it is also free. And that it is sure is indicated by the fact that since General Motors began to make use of it but one telegraphic transfer has gone astray in transit. As the corporation has approximately 100 banks throughout the country sending cash all the time through the federal reserve to certain selected depositories in Detroit and New York, and the total transfers average $1,500,000 a day, the working of the system appears to be close to 100 per cent perfect.

Process of Tuning Up Still Going On

As stated before, General Motors has reduced its "float" from ten millions to approximately four, with reasonable chances for success in reducing the amount still further. Starting with more than a hundred separate contingent accounts, the corporation has worked this number down to between 20 and 30. One division cut its number from 20 to 1. There is now one petty cash account for all branch managers, a plan which has so many advantages that everyone wonders why it was not done years ago.

Fluidity of cash, simplification of intercompany transactions, and reduction of contingent accounts are important factors in the tuning up of General Motors. But it may be that the most important of all lies ahead. It is possible that the big thing just ahead is to teach the true mission of industry itself. Mr. Pierre S. du Pont, Chairman of the Board of General Motors, struck this note when he said recently:

> Industry is founded upon the manufacture and sale of things that make this world a better place to live in. Industry has nothing to sell save useful service. . . . The divisions of General Motors Corporation have always been pioneers in the automotive industry, addressing themselves to the task of reducing the cost and increasing the utility of individual transportation for people and goods; also motorizing and electrifying the farm to help increase the supply of food. That, briefly, is the contribution of the divisions of General Motors to the sum total of useful knowledge.

Increasing the utility of motor transportation is the task of the engineers, the designers, the technical men. But reducing the cost is directly up to those who are wrestling with overhead and working to reduce capital requirements. As a means of reducing capital requirements the centralized cash plan has played an effective part for the General Motors Corporation.

Alertness as a Factor in Operation

Index Number
658.5 Shop management

A SMALL shop is often more efficient in minor things than a big shop. A small shop foreman has an intensive and detailed acquaintance with everything that goes on. He knows each man's methods and capacities, each machine's peculiarities, and all details of methods and processes. A big shop has so much machinery of communication and routine that the foreman may and often does lose direct contact with individual men, particular practice, and the details of how certain men apply certain methods.

Can the big shop ever hope to regain some of this efficiency of the small shop from which it evolved? The answer is, "Yes," especially if we use the partial advantages of the situation as well as accept the disadvantages.

The executives and foremen of one large plant intensify efficiency by inventing short-cuts and improving processes, improvements that cannot but bring a continual saving under mass production.

Value of Small and Large Shop Experience

Practically every one of these foremen used to be a small shop foreman during the early stages of growth of the company. As the plant expanded each department grew with it. Insensibly the foreman changed to look at things in their largest aspects rather than in detail, and this was necessary and advisable. Mass production is not obtained unless the foreman has a certain large view and looks for results without stopping to go into all minute details of the exact methods by which the results are secured. When a mass of results is scheduled, delivery on time is financially more important than possible small savings in manufacturing methods. The small incidental savings that a foreman might make in details would be more than wasted by the failure of the big streams of material to fit together in the proper quantity and predetermined time.

Yet, these small savings constitute an increment of possible profit. They are somewhat like a dump of a smelter. The time comes when it is very much worth while to put the waste through the smelter again, or at least through a scientific examination with a view to recovering additional value.

Suppose an order is to be put through which requires a special machine and a change in process, to make an increased quantity without increasing the floor area devoted to that work. The usual procedure is something like this: The engineer shows the foreman a sketch of the proposed means and methods. The foreman asks two questions: "Will it work?" "Can you install it in time to get the order started by such and such a date?" The designer says, "Yes." And the method is approved. The foreman does not ask: "Are you sure that it is the best method, not merely one of the practicable methods? Have you experimented to make sure that this is the cheapest way of doing it?" Time may not be taken to get exhaustive answers. Every day of delay in looking for perfection loses money for the shop, and then perfection might not be achieved. So mere practicability fills the bill. Under such routine many methods creep in which are excellent for their purpose at the time, but are not necessarily the best for permanent use.

In the shop referred to the foremen examine their processes intensively. They find marked improvements and short-cuts for many of them. In the aggregate they save a huge sum every year and substantially increase the speed of production.

Suppose a process is excellent in itself. When it is installed not every man in the shop learns to perform it in the best way. Again it is a question of getting things done. If a workman learns to duplicate a process with sufficient closeness so that the product will pass inspection, he is acceptable. The detailed motions and methods of the individual workman often have a great deal to do with the time he consumes or the real quality of his work. This is especially true in hardening and tempering and other metallurgical work.

But now with a changed point of view the foreman puts as much time as is necessary into watching each man's work. Being himself a skilled man of long experience, he can tell as no one else can, whether the workman knows and is actually applying the best methods and most intricate kinks which add so much to skill. So the foremen are getting back to bed rock on the actual carrying out of processes.

An Illustrative Instance

Here is a simple instance. One department was packing small articles in boxes of a certain shape and size before putting them into the ovens for case hardening. The foreman began to examine this method from the new viewpoint. He saw that a slightly different form of box would hold 50 per cent more material, take up very little more space, and require no more time in the fire. The time of packing these boxes would be very little longer. He made the change and now the time of labor and equipment per piece is cut down materially.

The design of each method is adapted to quantity production as well as small production. One of the questions that foremen and production men ask each other when changes are proposed at conferences is: "Will it work under all conditions?"

Foremen's conferences also exercise foresight to remove obstacles to efficiency. It pays handsomely to have ideas. Here is an advantage that the large shop has all its own.

Combine the small and large shop experience of a dozen foremen under skilful leadership and any operating problem will yield. The effect of this general operating policy, the constant review of details, has an almost amazing effect in keeping an organization alert. And, after all, alertness is what makes things progress in a manufacturing enterprise.

The Story Told by the Financial and Operating Statements

"Capital Requirements and Control"—Article Two

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Index Number
Financial control 658.14
Factory accounting 657.524

FINANCIAL statements and operating statistics are the final product of accounting procedure and should tell the story of the business—the condition of its finances, and the efficiencies and results obtained in its operations. But as such statements are commonly presented this story has to be read out of them by careful study and analysis.

Following is a typical financial report, such as will be found in daily papers, financial magazines, manuals, etc. It is the report of a well-known and representative company, with its statements slightly changed in order to conceal its identity. Statements such as this are found in the reports presented to business men daily. It is true that not all published reports contain as much detail on operations as is shown here, as many companies do not publish figures for sales and gross earnings, but in other respects it may be considered typical.

> "Of the financial statements read by the multitude of business men interested in and using such statistics, probably not one in a thousand tells the full story it should to its readers. Few business men are able fully to analyze and understand such a statement." With this in mind Mr. Bliss takes a typical financial statement and analyzes it so as to show the wide range of essential information that can be drawn from its figures.

A balance sheet is not the "cold statement" of assets and liabilities that it seems to so many readers of such statements. It is in fact a picture of the financial structure of an organization, stated in dollars and cents and indicating what the business owns, what it owes, and what it is worth net.

Consider the foregoing statement. Think of the items and the amounts given, not in sums of money, but look beyond the figures and see the quantities of goods, the investments represented, and the various sources from which capital is secured.

The balance sheet is presented as if in answer to the two leading questions which may be asked about the financial affairs of a business:

1. From what sources are funds drawn into the business?
2. How is such capital used or invested within the business?

The balance sheet shows on the one hand from which of the following sources the business draws its capital:

1. Stockholders' investments, which are represented by the original investment and the earnings left in the business.
2. Investments of bondholders; that is, capital secured on long-term loans.
3. Capital drawn from short-term borrowings, such as current notes and bills payable, accounts payable, sundry liabilities, etc.

The balance sheet indicates, on the other hand, how the organization has invested this capital in the business. That is, how much of it is tied up in:

1. Current assets, which are used in the daily transaction of business, such as cash, accounts receivable, inventories, etc.
2. Investments in plants and equipment, etc., which represent property in which business is carried on, and which are to be distinguished from the current assets turning over in the daily transactions of a business.
3. Investments in and advances to other companies—securities owned, such as stocks and bonds, etc.
4. Other types of fixed investments, such as deferred charges, intangible assets, good-will, trade-marks, etc.

It will be of very material assistance if the conception of the balance sheet as a picture of the financial structure of the business is kept in mind. One cannot read out of such a statement more than he sees in it. A complete analysis of any balance sheet requires the visualization of the various kinds of assets and investments which make up the financial presentation.

The asset side of the balance sheet should convey to the reader a picture of the financial conditions under which the business operates. He should visualize the stocks of goods moving through operations and on the way to market, and consider the turnover. He should measure the funds tied up in accounts receivable and

judge them on the basis of terms of sales, character of business, and general business conditions. He should consider the proportion of capital tied up in fixed property investments, and inquire as to the volume of business handled therein, noting whether advantages or disadvantages arise therefrom.

THE BALANCE SHEET

	Last Year	This Year
Assets		
Cash	$2,028,000	$2,361,000
Accounts and Notes Receivable	1,665,000	2,314,000
Inventories	3,392,000	6,245,000
Investments and Securities	1,436,000	1,636,000
Fixed Property Investments	13,610,000	15,040,000
Deferred Charges	1,341,000	1,928,000
	$23,472,000	$29,524,000
Liabilities		
Notes Payable	.....	$6,430,000
Accounts Payable	$323,000	1,210,000
Deposits and Advances Received	2,567,000	1,283,000
Bonds Outstanding	3,000,000	3,000,000
Reserves	1,101,000	1,005,000
Capital Stock	10,000,000	10,000,000
Surplus	6,481,000	6,596,000
	$23,472,000	$29,524,000

THE CONDENSED INCOME STATEMENT

	Last Year	This Year
Sales	$10,157,000	$10,380,000
Cost of Manufacture and Sales	7,889,000	7,550,000
Gross Margin	$2,268,000	$2,830,000
Expenses, Admin. and General	306,000	682,000
Operating Profits	$1,962,000	$2,148,000
Add Other Income	112,000	84,000
Deduct Interest Charges	180,000	180,000
Surplus Net Profits	$1,894,000	$2,052,000
Dividends Paid	1,987,000	1,937,000
Balance to Surplus Account	*$93,000**	$115,000

* Decrease in Surplus.

On the other hand, the manner in which capital is drawn into a business should be noted from the liability and capital side of the balance sheet. The methods of financing a business may yield substantial advantages or disadvantages to its stockholders. The proportion of capital secured from each of the various sources should be noted in view of the character of the investments. The working capital position, though not emphasized in the form of statement usually presented, is of prime importance. The character of long-term borrowings and the proportion to stockholders' investments may yield substantial advantages to stockholders and should be carefully noted.

Balance Sheet Variations

It is of the greatest importance that a concern should adopt and conform to a conservative basis for preparing its balance sheet statements. This is not alone an accounting affair but is as well a matter of sound business practice. The integrity and value of all statistics and financial statements is dependent upon the continuous observance of sound principles and conservative policies in preparing them.

Varying bases for valuing accounts in the balance sheet and inconsistent or irregular practices in handling accounts from year to year, not only affect the balance sheet but impair the value of the income statement and supporting statistics. The policy of providing reserves out of good years, and omitting charges in bad years—a pitch-fork method of accounting—cannot possibly affect the facts in the case, but only impairs the value of the statistics and makes them unreliable for use in studying the trends of the fundamental relationships in the business. To provide double depreciation in a good year and omit the charge in a poor year, does not stay the actual depreciation of the assets. It only impairs the cost statistics, income statements, and all other statistics involved. To value inventories on a bed-rock basis after a good year, and on an optimistic basis after a poor one, does not change the facts as to the real profits or losses, but only changes the statistics and books.

The Income Statement

The income statement reports the operations and transactions of a business for a definite period of time, states the volume of business done, the cost of sales, expenses, and results. This statement, together with the balance sheet, at the close of the period, makes up the financial report of the business. Each contains significant information in itself, but the two must be taken together, in order to read the full story of the business.

The income statement, particularly, tells the story of operations and transactions. That is its function. It should be presented in a form that will clearly answer the questions which a business man asks about his transactions. In fact, each section of the income statement states a concrete fact as if in answer to a pertinent question.

The following are the salient points to be emphasized by the various sections of the income statement of the average business:

1. The volume of sales for the period.
2. The cost of goods sold.
3. The margin of gross profits realized.
4. The selling, general, and overhead expenses.
5. The net profits realized from operations.
6. The amount of non-operating income and expenses, including interest charges.
7. The surplus net profits available for distribution in dividends, or transfer to Surplus account.

These divisions of the income statements are basic. The relationships between these various items, as expressed in ratio of profits, costs, and expenses on sales, are fundamental. While the amounts stated for sales, expenses, results, or other items are interesting, it is the relationships between these various items, the ratios, and turnovers, which are important.

The Return Earned on Net Worth

The measure of the earning power of a business to be noted first is the relation of the surplus net profits to the net worth. This measure states the earning power of the business from the stockholders' point of view.

It is the amount of profits realized on their investment in the business.

For example, referring to the report presented—found by adding capital stock and surplus and deducting from the sum the amount of surplus earned during the year—the return earned on net worth at the beginning of the year by this company would be figured in the following way:

	Last Year	*This Year*
Net Worth at Beginning of Year	$16,374,000	$16,481,000
Surplus Net Profits for Year	1,894,000	2,052,000
Percentage on Net Worth	11.45	12.45

This indicates an improvement in return earned over the preceding year of 1 per cent. This measure should be distinguished from the ratio of profits earned to capital stock. It is proper to figure the return earned on net worth because the surplus represents a part of the stockholders' investment in the business. It represents accumulated earnings which stockholders have seen fit to leave in the business and on which the business should be expected to earn a return.

Margin of Surplus Net Profits Earned on Sales

The relationship between surplus net profits and the sales for a period is the measure of earning power based on turnover, or volume of business done, as distinguished from the preceding ratio, which indicates the return earned on the total investment. These two are the measures to be applied to surplus net profits of the business. The one, is the ratio of profits earned on investment; the other, the ratio of profits earned on volume of business done. Both are basic measures of results.

The ratio of surplus net profits to sales is commonly expressed as a percentage of profits on net sales. It indicates the number of cents out of each dollar of sales realized net—after the deduction of all costs, expenses, interest, and extraordinary charges, and is the amount which is available either for distribution to stockholders as dividends, or to be transferred to Surplus account, thereby increasing their equity in the business.

The following illustrates the method of figuring the ratio of surplus net profits on sales for the financial statement preceding:

	Last Year	*This Year*		
Sales	$10,157,000	$10,380,000	Increase or	$223,000 2.2%
Surplus Net Profits for Year	1,894,000	2,052,000	Increase or	$158,000 8.3%
Percentage on Sales	18.6	19.7	Better by	1.1%

Here is to be noted a slight increase in the volume of business—2.2 per cent—and a substantial increase in the amount of surplus net profits, with the result that the margin on sales increased from 18.6 to 19.7 per cent. That is, out of each dollar of sales the company realized 1.1 cents more final net profits than in the preceding year.

The Book Value of Capital Stock

The book value of capital stock is the measure commonly used for expressing the value per share of the stock outstanding, as shown by the accounts and report of the company. This value is to be distinguished from the market value and the par value of shares.

The book value means the value per share of the stockholders' equity in the business—the net assets of the company—based upon the valuation at which assets and liabilities are carried on its books.

The following table illustrates the manner of figuring the book value of capital stock from the foregoing report:

	Last Year	*This Year*
Net Worth at Close	$16,481,000	$16,596,000
Shares of Stock Outstanding	100,000	100,000
Book Value per Share	$164.81	$165.96

Operating Profits Earned on Total Capital

The real measure of the earning power of a business is the operating profits earned on the total capital used in such operations shown by the asset footing of the balance sheet. This measure is to be distinguished from the return earned on net worth discussed previously. This ratio is a sounder measure of the earning power of the operations, because it is based on the net results realized from operations and the full amount of capital used therefor. It is clearly a measure of operating earning power.

The following table indicates the method of figuring this ratio for the financial report presented:

	Last Year	*This Year*		
Total Capital Used	$23,472,000	$29,524,000	Increase or	$6,052,000 26 per cent
Operating Profits	1,962,000	2,148,000	Increase or	$186,000 9.5 per cent
Percentage on Capital Used	8.35	7.26	Poorer by	1.1 per cent

Note here the unusually large increase in the amount of capital used—$6,000,000 or 26 per cent more investment at the close of the year than at the beginning. While the operating profits show 9.5 per cent increase over the preceding year, the increase in the investment used is so much larger that the average return upon the investment is reduced from 8.35 to 7.26 per cent.

The matter of economy and efficiency in the use of capital is just as important in the final success of the business as the efficiency or effectiveness of operations, merchandising, or other affairs.

Operating Profits Earned on Sales

The ratio of operating profits to sales is the measure of operating profits on turnover or volume. It is related or complimentary to the ratio of operating profits earned on the total investment employed. Therefore the two measures should be applied to operating profits both for the business as a whole and for any separate department, plant, or unit of the organization. The following table indicates the method of figuring the ratio of operating profits on sales from the foregoing report:

	Last Year	*This Year*		
Sales	$10,157,000	$10,380,000	Increase or	$223,000 2.2 per cent
Operating Profits	1,962,000	2,148,000	Increase or	$186,000 9.5 per cent
Percentage on Sales	19.3	20.6	Better by	1.3 per cent

With a small increase in sales volume, 2.2 per cent, and a larger increase in the amount of operating profits, 9.5 per cent, the ratio is improved from 19.3 to 20.6

per cent on sales. But note that even with this wider margin of profits on sales the return on the total capital used was smaller, as indicated in the preceding calculation because of the unusually large increase in the amount of capital used. The significance of this point should not be overlooked.

As pointed out in the preceding section this report shows a smaller return of operating profits on total capital used in the latter year, in spite of a wider margin of operating profits on sales. The reason for this is the poorer turnover of total capital used. The turnover of total capital used expresses the relationship existing between the volume of business done and the total investment employed. Obviously, the larger the volume of business done on a given investment the more favorable will be the return produced by any given margin of profit on sales. Sales of $1,000 made at a margin of 10 per cent will yield a return of 10 per cent on an investment used of $1,000, whereas if the sales were of $2,000 at the same 10 per cent margin they would yield a 20 per cent return on the same investment of $1,000.

The same point may be illustrated from the report under consideration. The following table shows the method of figuring the turnover of total capital used:

	Last Year	*This Year*		
Total Capital Used	$23,472,000	$29,524,000	Increase or	$6,052,000 26 per cent
Sales for Year	10,157,000	10,380,000	Increase or	$223,000 2.2 per cent
Turnover on Total Capital Used Stated in Dollars of Sales per Dollar of Capital Used	0.433	0.352	Poorer by	8.1 cents

Relation of Expenses to Sales

The ratio of expenses to sales is effectively stated in the percentages of such expenses to net sales. This indicates the cents out of each dollar of sales which are absorbed in expenses. In some industries volume is commonly stated in physical units—tons, hundredweights, barrels, cases, etc.—and this ratio is customarily figured in per unit costs. The percentage ratio is the sounder measure and expresses more accurately the basic relationships.

The following table shows the ratio of expenses to sales, figured from the foregoing report:

	Last Year	*This Year*		
Sales	$10,157,000	$10,380,000	Increase or	$223,000 2.2 per cent
Expenses	306,000	682,000	Increase or	$376,000 120.0 per cent
Percentage on Sales	3.0	6.6	Increased	3.6 per cent

Here is an increase in sales of only 2.2 per cent, while expenses more than doubled, with the result that the ratio increased from 3.0 to 6.6 per cent. That is, in the earlier year 3 cents of each dollar of sales was absorbed in the selling and overhead expenses, while in the latter year they increased to 6.6 cents out of each dollar of sales.

The gross margin earned on sales is the difference between the net sales and the cost of goods sold. In manufacturing industries this gross margin is commonly figured as the spread between sales and factory cost of goods sold. As factory costs include material, labor, and factory expenses this measure combines both merchandising and operating elements. In merchandising businesses this gross margin is figured as a spread between the net sales and the purchase cost of the goods sold, with the result that it is expressive of only the merchandising transactions.

The following table shows this ratio applied to the foregoing report:

	Last Year	*This Year*		
Sales	$10,157,000	$10,380,000	Increase or	$223,000 2.2 per cent
Gross Margin	2,268,000	2,830,000	Increase or	$562,000 24.8 per cent
Percentage on Sales	22.3	27.2	Increased	4.9 per cent

Note here the increase in sales of only 2 per cent, whereas the amount of gross margin increased 24.8 per cent, with the result that the ratio increased from 22.3 to 27.2 per cent on sales. This large increase in gross margin is more than half absorbed by the heavy increase in expenses, with the result that the operating profits show a much smaller proportionate increase than does the gross margin.

	Per Cent on Sales
The Gross Margin Increased from	22.3 to 27.2 or 4.9
The Selling and General Expenses Increased from	3.0 to 6.6 or 3.6
Operating Profits Increased from	19.3 to 20.6 or 1.3

Turnover of Inventories

The turnover of inventories is one of the basic measures of merchandising transactions. It expresses the rapidity with which stocks of goods are bought and sold—the turnover of that investment. Obviously the more business that can be done on the capital tied up in inventories, the more favorable will be the return on the investment produced by any given margin of profit.

The following table illustrates this turnover applied to the preceding report:

	Last Year	*This Year*		
Cost of Goods Sold	$7,889,000	$7,550,000	Less by or	$339,000 4.3 per cent
Inventories	3,392,000	6,245,000	Increased or	$2,853,000 84 per cent
Turnover—Times	2.33	1.21	Poorer by	1.12 times

As already noted, the turnover of total capital used was substantially slower in the latter year. One of the principal reasons for this condition is the poorer turnover of inventories noted in the above table. The cost of goods sold in the latter year was 4.3 per cent less than in the earlier year, but the amount of inventories carried increased 84 per cent with the result that the turnover in the latter year was only one-half as rapid as in the earlier year. With this condition the latter year would require twice as wide a margin of profit on sales to produce a given return on this inventory investment as would be required by the earlier year.

Turnover of Accounts Receivable

The margin of profit on a sale is fixed at the time the transaction is made. It does not become any larger, regardless of how long the account remains uncollected. On the other hand, the older the account becomes, the heavier the carrying expenses are, the larger the possibility of losses, and the poorer the return on the investment. The turnover of accounts receivable indicates the economy and efficiency observed in handling capital

tied up in accounts receivable. It may be effectively stated in the number of average days' sales outstanding in accounts receivable at the close of a period.

The following table shows this turnover applied to the report preceding:

	Last Year	*This Year*		
Sales	$10,157,000	$10,380,000	Increase or	$223,000 2.2 per cent
Accounts Receivable	1,665,000	2,314,000	Increase or	$649,000 39 per cent
Days of Average Sales Outstanding	41	67	Poorer by sales	23 days'

Note here that with an increase in volume of sales of only 2.2 per cent the amount of accounts receivable increases 39 per cent. At the beginning of the year there were outstanding in accounts receivable 41 days of average business, whereas at the end of the year the outstanding accounts amounted to 67 days of average business. This also is a factor in the slower turnover of total capital used, noted in an earlier paragraph.

Turnover on Fixed Property Investment

The turnover on fixed property investment is an effective method of stating the relation between the volume of business done and the amount of capital tied up in fixed plant and equipment investments. As fixed overhead expense burden—depreciation, insurance, taxes, etc.—bear quite a constant relationship to the amount of such property investments, it is obvious that the more business that can be done in a given period the more favorable will be the unit expenses and costs arising out of these fixed charges.

The following table shows this turnover applied to the report preceding:

	Last Year	*This Year*		
Sales	$10,157,000	$10,380,000	Increase or	$223,000 2.2 per cent
Fixed Property Investment	13,610,000	15,040,000	Increase or	$1,430,000 10.5 per cent
Turnover—Stated in Dollars of Sales per Dollar of Property Investment	0.75	0.69	Poorer by	6 cents

Here is an increase in volume of but 2.2 per cent, and an increase in plant investment of 10.5 per cent. The direct results are poorer turnover and heavier unit fixed expense burdens. The turnover here dropped from 75 cents to 69 cents of sales per dollar of plant investment. This also is a factor in the poorer turnover of total capital shown in an earlier calculation.

Working Capital and Ratio

The working capital position, that is, the relation between the current assets and the current liabilities of the business, is the point generally noted first in reading a balance sheet. It is probably more commonly understood than any other ratio or relationship to be read out of a balance sheet.

The net working capital is the difference between the total current, or liquid, assets in the business, i. e., its cash, accounts, and notes receivable, and the inventory, and its total current or quick liabilities, i. e., its notes and accounts payable, and its deposits and advances received. The ratio expressing the relationship between these is sometimes stated in percentage, or may be stated in dollars of current assets per dollar of current liabilities.

The following table shows the working capital position and ratio to be noted from the report preceding:

	Last Year	*This Year*		
Total Current Assets	$7,085,000	$10,920,000	Increase	$3,835,000
Total Current Liabilities	2,890,000	8,923,000	Increase	6,033,000
Net Working Capital	$4,195,000	$ 1,997,000	Decrease	$2,198,000
Ratio	2.45	1.23	Poorer by	one-half

This is a serious change: an increase in current assets of $3,835,000, an increase in current liabilities of $6,000,000, leaving a decrease in the net working capital of the business of $2,198,000, which is reflected in a ratio only one-half as good as at the beginning of the year. The several elements causing these changes are noted in later paragraphs.

Proportion of Earnings Left in the Business

Any going business finds it necessary, from time to time, to make additions and betterments to its properties and finds need for added working capital as volume increases. Except as these requirements may be financed by additional permanent investments in the business or long-time borrowing, the new capital necessarily must come from one of two sources—either current borrowings or profits left in the business.

In the case of the average concern, permanent financing does not occur every year, and its added capital requirements have to be cared for from earnings or current borrowings. But there is a limit to the amount which may be borrowed currently, and certainly it would not be conservative to invest funds borrowed on short terms in plants or other permanent investments. Hence, earnings left in the business are absolutely necessary to care for expansion and improvements.

The following table shows the disposition of surplus net profits indicated in the preceding report:

	Last Year	*This Year*
Surplus Net Profits	$1,894,000	$2,052,000
Dividends Paid	1,987,000	1,937,000
Balance to Surplus	93,000	115,000
Proportion of Earnings Left in Business	None	5.6 per cent

Note here that while two years of operations have produced quite satisfactory surplus net profits there has been left in the business out of almost $4,000,000 of profits, only $22,000 or less than 1 per cent.

From the published reports of 236 representative companies it appears that 43 per cent of the annual earnings of the war and post-war years were left in the business.[1]

The report discussed in the present article appears in substantially the form published in the daily newspapers. It is, as already stated, a typical published report. It is also about the form in which balance sheets and income statements are usually presented in auditors' reports and to business executives by industrial accountants.

How much more effective these reports would be if presented in analytical form! How much more the average business man would read out of them, and how

[1] "Financial and Operating Ratios in Management," J. H. Bliss, p. 183.

much more value they would prove to him if they carried the analysis of ratios and relationships which may be so readily supplied!

The following balance sheet and income statement shows the same report carrying analytical data:

THE BALANCE SHEET IN ANALYZED FORM

	Last Year		This Year		Increase or Decrease
	Dollars	Per Cent	Dollars	Per Cent	
Assets					
Cash	2,028,000	8.6	2,361,000	8.0	$333,000
Accounts and Notes Receivable	1,665,000	7.1	2,314,000	7.8	649,000
Inventories	3,392,000	14.5	6,245,000	21.1	2,853,000
Total Current Assets	7,085,000	30.2	10,920,000	36.9	$3,835,000
Investments and Securities	1,436,000	6.1	1,636,000	5.5	200,000
Fixed Property Investments	13,610,000	58.0	15,040,000	51.1	1,430,000
Deferred Charges	1,341,000	5.7	1,928,000	6.5	587,000
	23,472,000	100.0	29,524,000	100.0	$6,052,000
Liabilities					
Notes Payable			6,430,000	21.9	$6,430,000
Accounts Payable	323,000	1.4	1,210,000	4.1	887,000
Deposits and Advances Received	2,567,000	11.0	1,283,000	4.4	*1,284,000*
Total Current Liabilities	2,890,000	12.4	8,923,000	30.4	$6,033,000
Bonds Outstanding	3,000,000	12.7	3,000,000	10.0	
Reserves	1,101,000	4.7	1,005,000	3.4	*96,000*
Capital Stock	10,000,000	42.6	10,000,000	34.0	
Surplus	6,481,000	27.6	6,596,000	22.2	115,000
	23,472,000	100.0	29,524,000	100.0	$6,052,000

THE INCOME STATEMENT IN ANALYZED FORM

	Last Year		This Year		Increase or Decrease
	Dollars	Per Cent	Dollars	Per Cent	
Sales	10,157,000	100.0	10,380,000	100.0	$223,000
Cost of Manufacture and Sales	7,889,000	77.7	7,550,000	72.8	*339,000*
Gross Margin	2,268,000	22.3	2,830,000	27.2	562,000
Expenses, Admin. and General	306,000	3.0	682,000	6.6	376,000
Operating Profits	1,962,000	19.3	2,148,000	20.6	186,000
Add Other Income	112,000	1.1	84,000	0.8	*28,000*
Deduct Interest Charges	180,000	1.8	180,000	1.7	
Surplus Net Profits	1,894,000	18.6	2,052,000	19.7	158,000
Dividends Paid	1,987,000		1,937,000		*50,000*
Balance to Surplus Account	*93,000*		115,000		208,000

Summarizing Changes in Financial Position

While the foregoing analyzed report emphasizes a great many of the points to be noted from such statements there are large advantages in summarizing these reports, by stating the changes in financial position, and the important changes in ratios. It is a very simple matter to summarize all of these changes and ratios in such a manner that they may be readily understood by anyone who should use the information in the conduct of a business.

The changes in financial position shown in the foregoing report may be stated in different ways. The following will emphasize some of the outstanding changes which should be noted by those who might make use of this particular statement. In preparing such a summary the points should be particularly emphasized which should come to the attention of those interested in the report.

The following will illustrate:

The current liabilities increased.....$6,033,000
The current assets increased..... 3,835,000

Resulting in a decrease in the net working capital of the business of.....$2,198,000

This amount of money has been withdrawn in some manner from the net working capital of the business.

In addition to the foregoing there were surplus net profits earned, which first became added net working capital. These amounted to $2,052,000

Together, these make the total of funds withdrawn from working capital, and disposed of outside of the business, or permanently tied up in fixed investments amounting to.....$4,250,000

These funds were disposed of as follows:

Dividends paid.....$1,937,000
Invested in Plant..... 1,430,000
Invested in additional securities..... 200,000
Tied up in increased deferred charges..... 587,000
Reserves liquidated..... 96,000

Total as above.....$4,250,000

The important changes in ratios and relationships occurring during the year were as follows:

1. A small increase in volume of sales. 2.2 per cent.
2. A wider gross margin earned on sales. 22.3 to 27.2 per cent—Increase 4.9 per cent.
3. Heavier selling and general overhead expense, 3.0 to 6.6 per cent—Increase 3.6 per cent.
4. Leaving a small increase of margin of operating profits, 19.3 to 20.6 per cent—Increase 1.3 per cent.
5. And a smaller increase in surplus net profits on sales, 18.6 to 19.7 per cent—Increase 1.1 per cent.
6. Which yielded a better return on stockholders' investment, 11.4 to 12.4 per cent—Increase 1.0 per cent.
7. But operating profits on the total capital used were poorer, 8.35 to 7.26 per cent—Decrease 1.1 per cent.
8. Because of poorer turnover of total capital used, 43.3 to 35.2 cents—Decrease 8.1 cents.
9. Which was the result of poorer turnovers of inventories, 2.33 to 1.21—Slower 1.1 times.
10. And poorer turnovers of accounts receivable, 44 da. to 67 da.—or 23 da. sales.
11. And poorer turnover on plant investment, 75 to 69 cents—Poorer by 6 cents.

In addition to the foregoing the following conditions should be noted:

1. The volume of sales increased 2.2 per cent.
2. The inventories carried increased 84.0 per cent.
3. The accounts receivable outstanding increased 39.0 per cent.
4. The plant investment increased 10.5 per cent.
5. Ninety-five per cent of the profits were paid out in dividends.
6. The net working capital was cut in two.
7. The ratio dropped from 2.45 to 1.23.

Can it be doubted that such analyses of financial statements placed before the average business man would be welcome and also prove useful in the better management of business affairs?

Planning the Repetitive Manufacture of Automobile Wheels

"Practical Methods for Planning Work"—Article Six

By WILLIAM B. FERGUSON

Consulting Engineer

Index Number
658.51 Planning
658.54 Rate-setting

IN this last article on planning methods will be outlined some of the methods used in quantity production or the making of a great number of parts of the same design, with respect to those features which are more or less peculiar to this class of work as compared to the other classes described in previous articles. The former dealt with four different classes of work, each of which is considerably different from manufacturing in large quantities, namely: 1. large repair or rebuilding work, such as reconditioning the giant passenger ship "Leviathan"; 2. construction work, such as the building of a large swimming pool; 3. repair work on locomotives and freight cars; 4. the manufacture of freight cars "on order."

When it comes to quantity production we meet with a new set of problems which require planning, and to which more scientific methods of setting rates and standards of performance can be applied, as compared to the other classes of work mentioned.

Construction of the Double Disc Wheel

The particular kind of manufacturing which will be used as an example for illustrating the principles and methods involved is the manufacture of automobile wheels of the double disc type. The peculiar construction of this wheel must be described to make clear the operations involved in its manufacture.

Between the two metal discs there is inserted an annular ring of fabric shown in Fig. 54. This fabric ring is riveted to the metal discs and the construction is shown in Fig. 55.

Before describing the various operations required to make this wheel and the methods used in quantity production, it seems advisable to cover some of the general principles of manufacturing in quantities, by speaking of the methods of control of materials, equipment, and production, which were used in a very large plant employing 12,000 men, engaged in manufacturing military rifles and bayonets by the million for our Allies in 1915, 1916, and 1917. These methods were employed in the rifle plant of the Remington Arms Company at Bridgeport, Connecticut, of which I was production manager in 1916-1917.

The planning functions were concentrated in the planning department under my charge. I also had control of ordering tools, fixtures, and gages, the "balance of stores" or storeskeeping system, the inspection of raw materials, the timekeeping system, counting parts, finished stores, and all scheduling, routing, and control of the flow of materials throughout the plant. In addition to this, the piecework or rate-setting department was under the production manager, and a special floor about 80 by 200 feet, was set aside for time studies and rate-setting

FIG. 54 THE "FLEXSILIENT" AUTOMOBILE WHEEL
It is constructed of two annular steel discs and a steel felloe connected by a laminated ring of fabric.

under a piece-rate superintendent, who developed a staff of about 45 men engaged in this work. The "Budget System" of cost control was also controlled by the production manager. The general superintendent with 15 superintendents carried out the plans of the production manager.

As we review the various functions that have to be performed in economical manufacturing, we should not lose sight of the main objective, which is to produce articles in quantity at a minimum manufacturing cost,

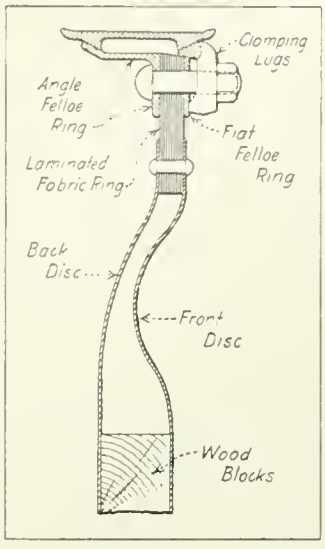

FIG. 55 CROSS-SECTION OF THE "FLEXSILIENT" WHEEL

The special feature of this wheel is the non-metallic fabric ring interposed between the hub and the rim. This ring is built up of 13 plys of "square" woven cotton duck which is rubberized and vulcanized in a full mold, similar to standard tire practice. A 7/16 in. gap between the felloes and the steel discs makes it a "suspension" wheel, the weight of the car being suspended in the fabric ring. The fabric ring is 7/16 in. thick, 23 3/16 in. O. D. and 18 in. I. D. It is riveted with 48 ¼ in. rivets between two steel discs, made of 0.16—0.20 carbon full cold-rolled stock 0.078 in. thick and fastened to the felloe rings with 42 ¼ in. rivets.

taking all elements of cost into account. We must also remember that speed of production with a definite number of machines and available workmen is a corollary or attribute of low labor costs, and that any effort to make speed in the ordinary way by rushing or crowding the foremen before the work is properly planned, not only increases the labor cost, but defeats the very purpose which this type of management is trying to accomplish. Instead of increasing production there results a slowing up of production and lowering of quality which cannot be avoided.

Having in mind the main objectives of low production cost and high quality, we must realize that the weekly output of good pieces per man is generally the real criterion for economy. As between unplanned and planned manufacturing we do not have to prove to those who have tried both ways, that the output per man can be frequently doubled and sometimes quadrupled by real planning and finding out "the one best way" to perform an operation. The question of wages and how much men are paid for a day's work is often confused with the question of economical production or production at low cost. It is quite possible for a factory to produce and sell articles in quantity considerably below its competitors, in spite of paying higher wages, by increasing the output per man by proper planning and control methods. My experience has been that this statement is somewhat of a mystery to most manufacturers. When you make a statement like this, they shake their heads dubiously and feel sorry for your having such foolish ideas.

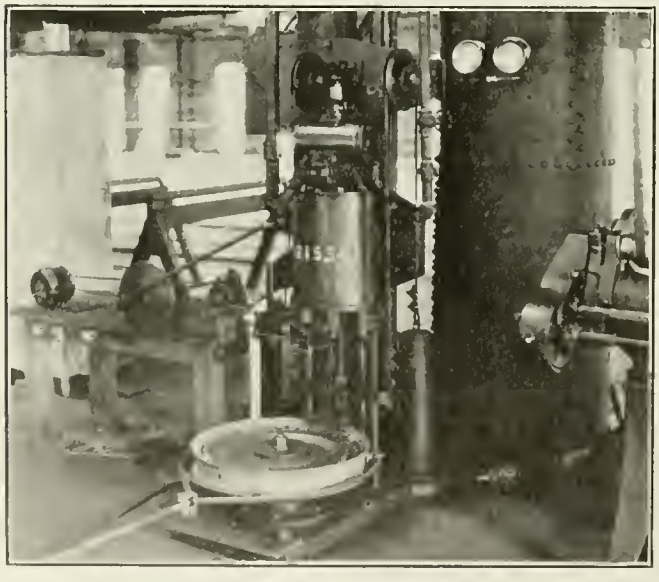

FIG. 56 TESTING THE LATERAL DEFLECTION OF A "FLEXSILIENT" WHEEL

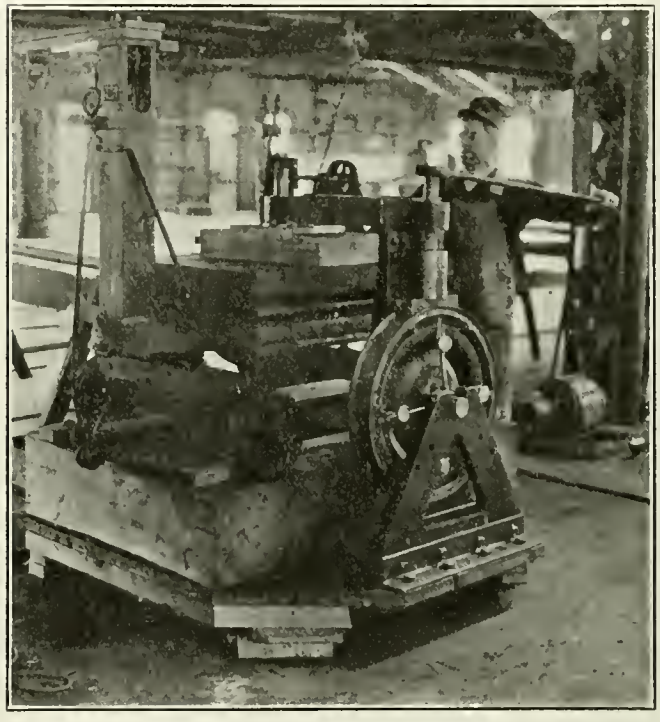

FIG. 57 A COMPRESSION LOAD TEST OF A "FLEXSILIENT" WHEEL

The load being applied is 50,000 lb. Note the use of dial indicators to measure deflections.

The trouble seems to be that frequently managers, superintendents, and foremen seem to think that the best performance that is possible on any operation is the record which they have themselves supervised. At Bridgeport our experience in this respect was not unusual. When we established the special department to set piece rates for the 3000 distinct operations in the factory, and installed temporarily in this department a machine of each type used in the factory, the foremen who had had years of previous experience in making military rifles, shook their heads wisely and said that this was all foolishness. The foremen had already submitted to the management their proposed piece rates for the factory on practically all the operations involved, and saw no reason why anyone should question the accuracy of their estimates.

The rate-setting department, after about four months of intensive study (during which hitherto unskilled men performed, under proper instruction and the guidance of five expert mechanics, each operation in the factory) had worked out and tried out the time allowance for every operation. This was nearly all done before the factory started any piecework at all.

Then came the difficulty of introducing the rates,

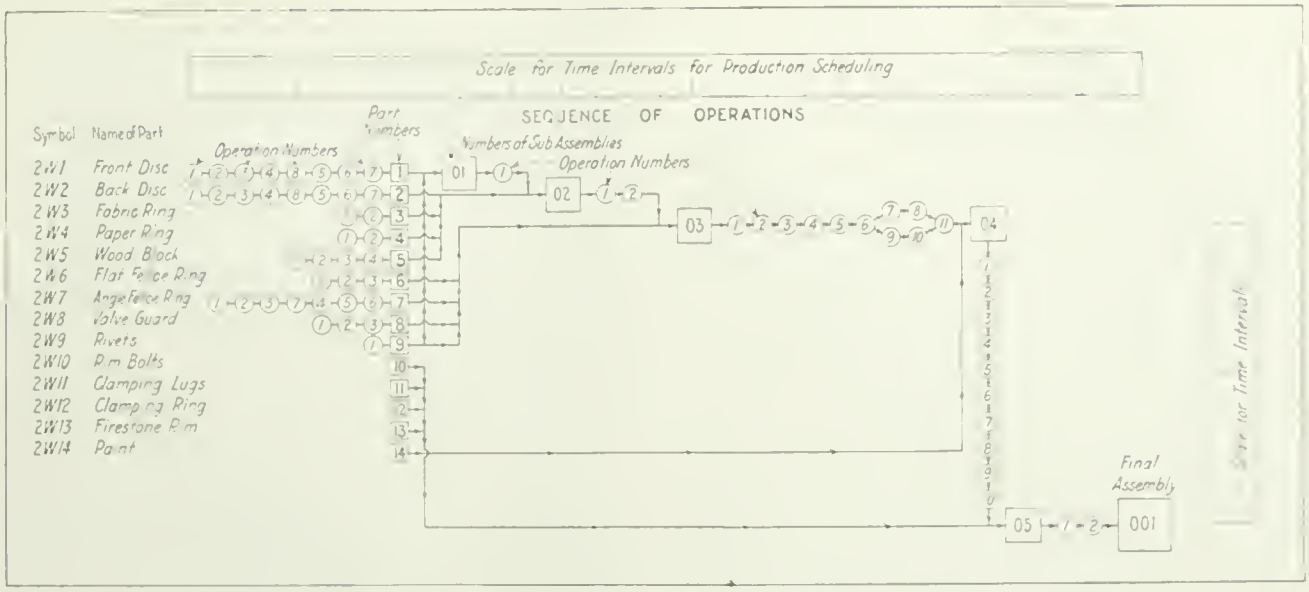

FIG. 58 SEQUENCE OF OPERATIONS OF THE "FLEXSILIENT" WHEEL

This chart shows each manufacturing operation, each subassembly and the final assembly. Note the use of two time interval scales, one across the top, the other at the right-hand end.

because in nearly every case the proposed rates or time allowances were less than half of the original rates recommended by the foremen. On hand-work operations, as polishing, the times allowed were in some cases only one-fifth or one-sixth the time previously set or recommended by the foremen. We started out in the factory on one operation at a time, the first one being a simple drilling operation. The foremen protested that the rates were not right, and that the men could not possibly make out on the time allowed; and if we were going to try anything like that, we had better close up the factory. We exercised considerable patience and tried our best to be cheerful and pleasant under the circumstances, pending the demonstration by our rate-setters that the work could be done within the time allowed.

The demonstrator of the rate-setting department took one of the machines in the factory proper on which the work was to be done, under the foreman's observation, and performed the operation himself for a period of four hours, or until the foreman was satisfied that the demonstration was long enough to give a fair result. We only had to demonstrate the first four operations on which rates had been set. Our allowances on the remainder of the 3000 operations were scarcely questioned, as we always had a demonstrator at hand. The demonstrators in each case (bear in mind that the demonstrators were just ordinary mechanics trained and instructed properly) showed the foremen that the average mechanic could do the work in considerably less than the time allowed, if he followed instructions. There was a complete instruction card for each operation, giving the speed, feed, and cut, etc., or other specific data as required. One by one the foremen accepted and adopted the piece rates set, instructed their men how to do the operations according to the instructions and within three months' time every operation in the factory was on piecework in the manufacturing departments, and the pay-roll labor cost per unit had been cut 33 per cent, or one-third, while the daily output had been increased 72 per cent.

Do not think that this result was due entirely to

FIG. 59 GENERAL VIEW OF THE ASSEMBLY DEPARTMENT OF THE WHEEL SHOP

Note the methods of stacking, nesting, and transporting steel discs, arrangement of machinery and work spaces, and orderliness.

the proper setting of piece rates, although this had its share in the program. As mentioned in previous articles there are many essential things that have to be done before piecework or any other incentive system can be put into effect properly, and the establishment of proper performance standards is only one step. The control of the "flow of materials," beginning with the issuing and delivery of raw materials from the storehouses to the incoming station on each of the 70 floors, and ending at the assembly departments, had something to do with the results. The Budget System of Cost Control had a lot to do with them. The inspection system, which has been so well described by G. S. Radford,[1] had much more to do with the results than can be appreciated, without considering as one production system all the elements of inspection, routing, dispatching, rate-setting, and other necessary mechanisms of management. All these matters, of course, are dependent in turn on proper designs of product and equipment and tools.

Job Analysis

In fact the same thought always bobs up in my mind in trying to differentiate between the various important elements of manufacturing, when I am asked which I consider the most important, and that thought was expressed by Abraham Lincoln in replying to a similar question as to which he considered the most important branch of the government—the executive, the legislative, or the judicial. He answered it as an Englishman would, by asking another question:

"*Which leg of a three-legged stool do you consider the most important?*"

There are several things which are much easier to handle in the way of planning methods in quantity production or repetition manufacturing than in construction work, repair work, or small quantity manufacturing. One of these things is what is commonly known as "job analysis." It has long been accepted in quantity production as an established method of starting the job, that job analysis is the very first thing that anybody ever thinks of doing. The object to be manufactured is analyzed into its elements. A list of component parts or pieces is first made up, a detailed working drawing is prepared for each piece, and the exact method of manufacture of each part, and the exact methods of subassembling and final assembling are carefully studied, and carefully recorded. The usual *casual* study given to ordinary production is not considered a study at all in quantity production. That is merely a starter.

In manufacturing, each operation is listed up in complete detail and the various alternative methods which might be used in making the pieces and in assembling operations are considered and compared; and the best probable sequence of operations is gone over. Usually a manufacturing committee sits on this proposition, and the various proposed methods are actually tried out in practice before the standard method is adopted. This work goes on concurrently with the experimental or rate-setting department, so that the standard method is actually tried out for a considerable period before the manufacturing departments are allowed to proceed with manufacturing. Then the agreed standards and the agreed sequence of operations are rigidly adhered to. This is vital.

In the development of the manufacturing operations now used on the double disc wheel described above, or what is known as the "Newport News Flexsilient Wheel," over a year was spent in designing, experi-

[1] "The Control of Quality in Manufacturing," by G. S. Radford.

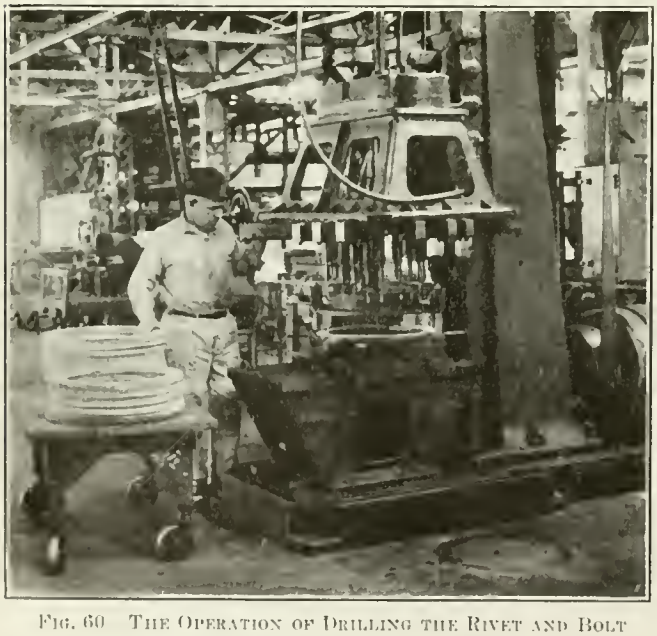

FIG. 60 THE OPERATION OF DRILLING THE RIVET AND BOLT HOLES IN THE FABRIC RINGS

FIG. 61. THE OPERATION OF ROLLING THE STEEL ANGLE FELLOE RINGS

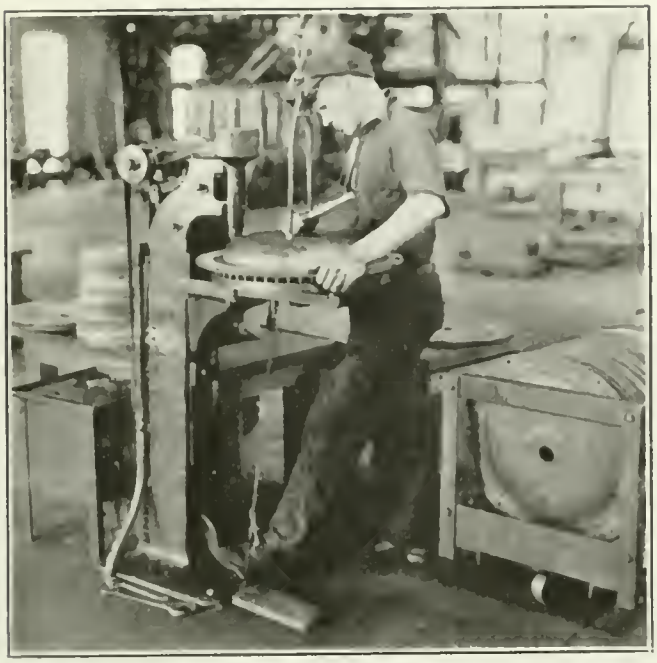

FIG. 62 THE OPERATION OF RIVETING IN ASSEMBLING THE DISCS

mental and development work as to the method of construction and methods of performing the operations required, before the factory started manufacturing. The testing apparatus, a part of which is shown in Figs. 56 and 57, and the results shown therewith had a lot to do with the wheel design, construction, and methods of manufacturing.

The flexsilient wheel consists of 7 principal parts as follows: 1, front disc; 2, back disc; 3, laminated fabric ring; 5, wood blocks; 6, flat felloe ring; 7, angle felloe ring; 8, valve guard.

The numbers used are those used in the operation list in the factory. In addition to these part numbers, the other parts are numbered as follows; 4, paper ring; 9, rivets; 10, rim bolts; 11 clamping lugs; 12, clamping ring; 13, firestone rim; 14, paint.

The principal reason for selecting such a simple product to present planning methods in repetition manufacturing is that in a brief article of this kind can be shown the nature of some of the operations involved, and the complete relation or dependent sequence between operations, as well as between single parts, subassemblies, and final assemblies.

Fig. 58 shows the dependent sequence of all operations on the wheel. (See list of operations in Table 5.) The arrow points toward the dependent operation —for example, operation 1-3 cannot be performed until operation 1-2 has been completed. In the same way the parts going to make up the subassemblies are bracketed and the relationship between parts and subassemblies is indicated by thin lines and arrow points.

Fig. 59 shows the general view of the assembly department of the factory, during the experimental stage, before production in quantities was started.

Figs. 60, 61, 62, and 63 show specific operations as follows:

Fig. 60 shows the Baush type No. 3 multiple spindle drill, drilling the holes in the laminated fabric ring, operation 3-1.

Fig. 61 shows the rolling of the angle felloe rings, operation 7-2.

Fig. 62 shows the riveting of the "disc assembly," operation 02-2.

Fig. 63 shows the painting operation which is done by a spraying machine, operation 04-1. In this view we see the paint room and the enameling ovens in which the finished wheels are baked for four hours at 160 deg. fahr.

In connection with the diagram of Sequence of Operations, Fig. 58, the list of operations, Table 5, should be referred to. Although the "sequence" originally planned was later changed, sometimes by the insertion of additional operations, yet the distinguishing numbers were not changed, which is approved practice.

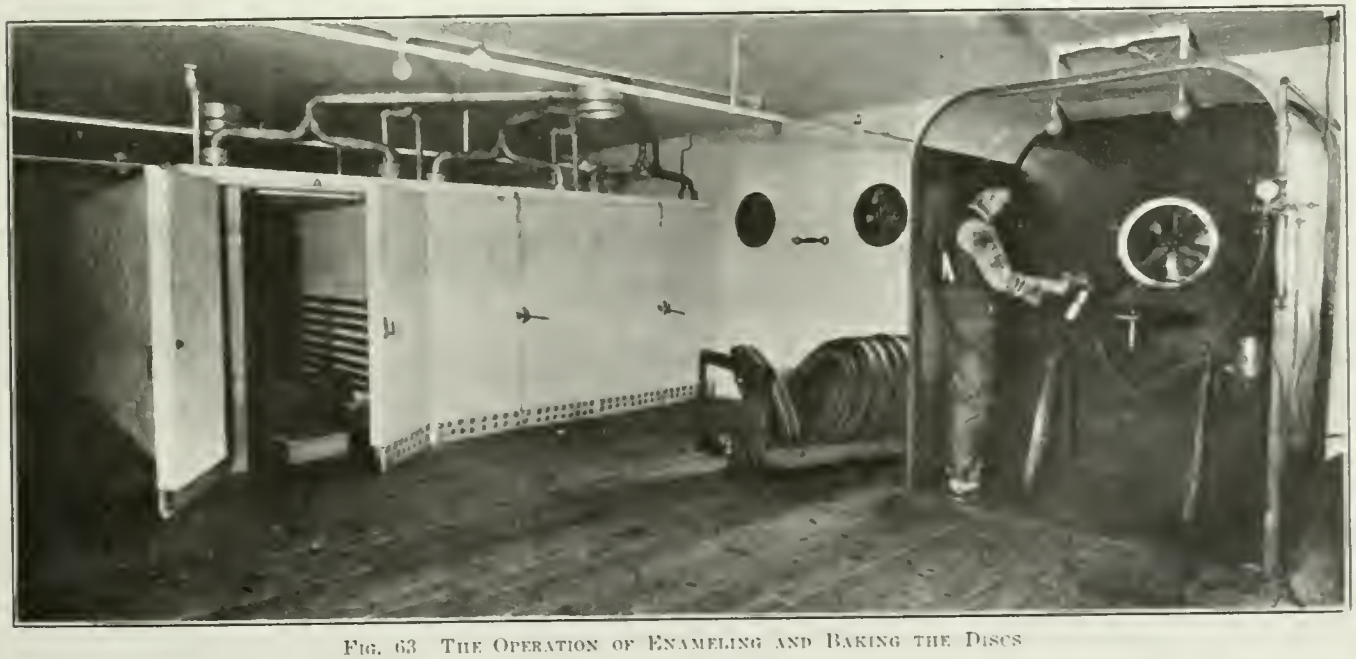

FIG. 63 THE OPERATION OF ENAMELING AND BAKING THE DISCS

Note the spray painting apparatus used within a ventilated hood, also the close proximity of the ovens.

As an illustration of the methods used in setting standard times or piece rates for various operations—in which results were accomplished comparable to those above mentioned in rifle manufacturing—during the experimental stage on the Newport News Flexsilient Wheel careful time studies were made of each operation, and then a small group of mechanics (who corresponded to the demonstration men who would be used in a large manufacturing establishment) were put to work on the various operations in rotation, and were told that they would be paid extra money at the proposed preliminary piece rates, and the amount of work they could turn out would determine to a large extent the success of the management in marketing the produet. These demonstrators were assured that they would later become inspectors and they started on the job with this encouragement, with mutual confidence existing between them and the shop superintendent and other supervisors. The result was that before the experimental work was completed on 4000 wheels, the real standard times for the various operations were determined to be about one-half of what the time-study men had thought they would be from their time studies. The "time-study" standard times, in turn, were about half the previous actual time taken by day workers. So you see the output per man was eventually quadrupled.

TABLE 5. OPERATIONS IN MANUFACTURING THE FLEXSILIENT AUTOMOBILE WHEEL

COMPONENT OR PART	OPERATION
1. Front disc	1. Shearing sheets on gate shears. 2. Cutting circles on circle cutter. 3. Forming dies on press. 4. Punching rivet holes on press. 5. Trimming and rolling edge on lathe. 6. Cutting out valve guard notch on punch. 7. Dressing valve guard notch by hand. 8. Retrimming on circle cutter.
2. Back disc	1. Shearing sheets on gate shears. 2. Cutting circles on circle cutter. 3. Forming discs on press. 4. Punching rivet holes on press. 5. Trimming and rolling edge on lathe. 6. Cutting out valve guard notch on punch. 7. Dressing valve guard notch by hand. 8. Retrimming on circle cutter.
3. Fabric ring	1. Drilling rivet and bolt holes on multiple drill. 2. Punching valve guard holes on punch.
4. Paper ring	1. Cutting center hole in paper ring. 2. Cutting out paper rings.
5. Wood blocks	1. Dressing lumber in joiner shop. 2. Sawing boards into squares on saw. 3. Boring center hole in drill. 4. Sawing outer circle on band saw.
6. Flat felloe ring	1. Pointing end of bar and bending on rolls. 2. Sawing on hack saw. 3. Punching rivet and bolt holes on press.
7. Angle felloe ring	1. Pickling angle. 2. Bending on rolls. 3. Sawing on hack saw. 4. Punching rivet and bolt holes on press. 5. Squaring bolt holes on punch. 6. Milling driving lug holes. 7. Splitting rings on hack saw.
8. Valve guard	1. Patterns. 2. Drilling rivet holes. 3. Grinding face on grinder
9. Rivets 10. Rim bolts 11. Clamping lugs 12. Clamping ring 13. Firestone rim 14. Paint	1. Forging on rivet machine.

SUBASSEMBLIES	OPERATIONS
Part 01 Rivet part 2W1 02 Assembly of 1. Front disc 2. Back disc 3. Fabric ring 4. Paper ring 5. Woodblock 9. Rivets	1. Tacking together pts. 1, 2, 3, 4, 5, 9. 2. Riveting on spinner.
03 Assembly of 02 6. Flat felloe ring 7. Angle felloe ring 8. Valve guard 9. Rivets	1. Tacking together pts. 01, 6, 7, 8, 9. 2. Riveting on blow riveter. 3. Welding angle felloe ring. 4. Dressing—weld with grinder. 5. Testing 03 for truth and inspection. 6. Applying rust preventative to 03. 7. Drilling hub bolt holes on drill. 8. Countersinking burr from bolt holes. 9. Boring hub on vertical mill. 10. Dressing hub bore with file. 11. Cleaning C3 for painting.
04 Fourth subassembly (Ready for painting)	1. Apply first cost of enamel by spraying with pistol. 2. Baking in oven. 3. Rubbing down. 4. Spraying second coat. 5. Baking second coat. 6. Rubbing down. 7. Spraying third coat. 8. Baking third coat. 9. Retouching and inspection.
05 Assembly of 04 10. Rim bolts 11. Clamping lugs 12. Clamping ring 13. Firestone rim	1. Assembling. 2. Final inspection.

To illustrate the necessity for intensive study of equipment design and also to show the kind of instruction developed and used for the various operations, take as a sample, operation 5—trimming and rolling edge on lathe (Model No. 2, part No. 1).

This description with sketches was prepared by J. C. Sterling:

This operation was done on a 24 in. American Engine Lathe. One man is required for the operation. The disc is held on a false face plate bolted to the face plate of the lathe and clamped to the false face plate by a ball-bearing clamp held in a dead center socket in the tail stock. There were two developments of the false face plate. The first plate used was 20 in. in diameter and was used in conjunction with the large face plate of the lathe. See Fig. 64.

The above jig did not prove satisfactory. Catching the drive pin in a rivet hole took time and was dangerous in its liability of catching in the operator's jumper sleeves. Also there was a tendency for the chips to collect between the disc and the false face plate, and whirling around inter-

I appreciate the fact that time-study work on day workers has its value, and that in the course of time piece rates can be set on the basis of such time studies provided every operation is dissected into its ultimate motions, and a real motion study made. The result mentioned above, however, was accomplished in much less time than by the ordinary time-study method, because the additional interest which was created by the management on the part of the demonstrators brought forth such improvements in methods of handling the work that the best guess of the best time-study man was all shot to pieces In other words, the difference between time studying an average mechanic on day work and time studying the same mechanic who is being paid for being a "part of the management" is so tremendous in actual practice that I have been forced somewhat against my judgment, during the last five years, to put more emphasis upon the spirit and will to produce than upon the mechanical methods or motions which the scientific time-study man advocates.

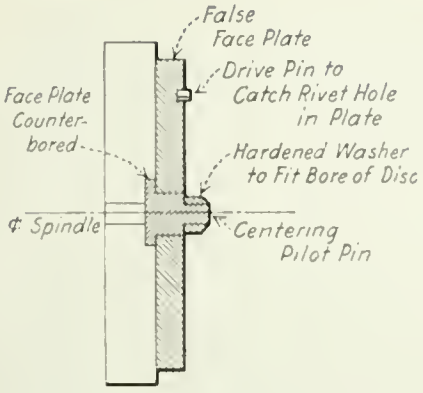
False Face Plate
Drive Pin to Catch Rivet Hole in Plate
Face Plate Counter-bored
Hardened Washer to Fit Bore of Disc
℄ Spindle
Centering Pilot Pin

FIG. 64 FACE PLATE USED IN TRIMMING AND RULING EDGE OF DISC

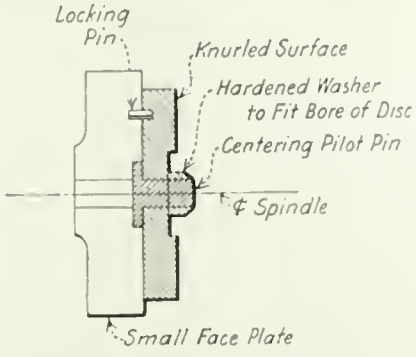

FIG. 65 IMPROVED DESIGN OF FACE PLATE SHOWN IN FIG. 64

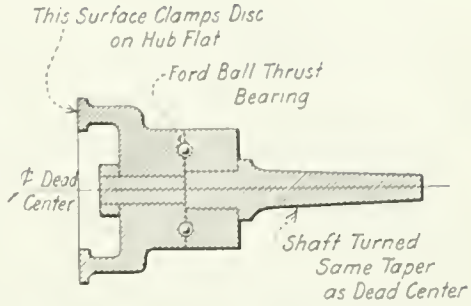

FIG. 66 TAIL STOCK CLAMP USED WITH FACE PLATE OF FIG. 65

fered with the operation. The above jig was made from pencil sketches.

To overcome the disadvantages of this jig another was designed and built which proved satisfactory. In this the small face plate was used and the drive pin eliminated, the disc being driven by being clamped against a hardened, knurled plate. A sketch of this jig is given in Fig. 65.

Details of this jig were given on a special drawing.

The tail stock ball-bearing clamp was built from pencil sketches. A sketch of the arrangement is given in Fig. 66.

Much of the speed of this operation was obtained by use of the combined trimming and rolling tool illustrated in Fig. 67.

The details of this tool were shown on a special drawing. The cutting-tool bitt was ground as shown in Fig. 68.

It was found that this shape of the tool gave the best result in curling the chip and preventing chattering. If the tool chatters, a good rolled edge is hard to obtain. The shape of the roller groove is very important. A special drawing was made for this. Rough sketch of the roller is shown in Fig. 69. The design of the roller and the theory of its operation were given considerable attention. Details of this will be omitted for the sake of brevity. Fig. 70 shows the difference between a metal disc properly and improperly rolled.

The operation is performed as follows:

The false face plate, knurled plate, and pilot are bolted to the small face plate. The ball-bearing clamp is mounted in the dead center socket, with the tail stock set forward so that there is about 3 in. opening between the clamp face and the face plate jig. The rolling and trimming tool is mounted in a boring bar tool post and the carriage is locked, with the center of the roller groove in line with the edge of the disc. There is a stop attachment on both the cross feed and the hand feed, and these are set so that when both feeds are hard against the stop the trimming tool has trimmed the disc to the correct diameter. These settings are obtained by trial. Once set they are not changed for the same diameter of disc, the tool bitt being set to the same projection in the holder by using a tool guage each time it is removed for grinding, or replaced.

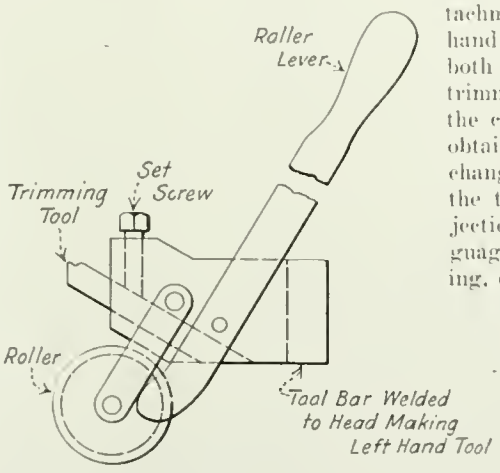

FIG. 67 COMBINED TRIMMING AND ROLLING TOOL

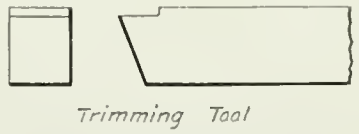

FIG. 68 DETAIL OF TRIMMING TOOL IN FIG. 67

The lathe is kept running continuously. The operator picks up a disc from the unfinished pile with his left hand, slips it on over the pilot pin, the inside of the disc (the side that touches the wood block) against the knurled plates. He then spins the tail stock hand wheel with his right hand and as the plate is clamped, starts feeding in the tool with his left hand. With a light wire hook in his right hand he "hooks" away the long curling chips and thus keeps the tool clean. When he feeds in until he hits the diameter gaging stop, he backs off his tool about $\frac{1}{4}$ in. and shifts his left hand to the roller lever, and pulls the roller forward against the disc. He lays aside the hook with his right hand and picks up a 1 in. paint brush from an oil tin. With this brush he lightly oils the edge of the disc while being rolled, making the rolling action smoother and quicker.

This is one of the prettiest of the

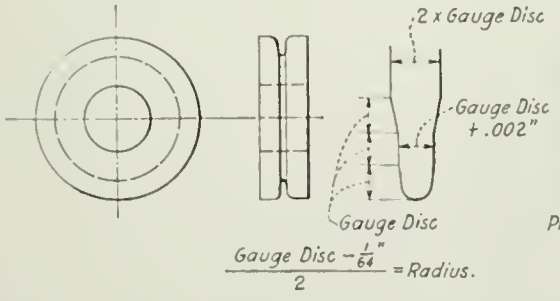

FIG. 69 DETAIL OF ROLLER TOOL IN FIG. 67
In which the shape of the groove is of particular importance.

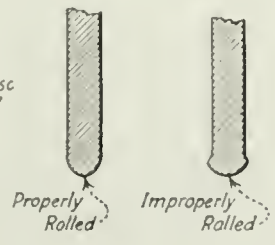

FIG. 70 CROSS-SECTION OF PROPERLY AND IMPROPERLY ROLLED EDGE

manufacturing operations to watch. The operator is using both hands all the time. He becomes very proficient in getting a smooth edge, testing the same with his right thumb and forefinger while in motion.

The "time-study" standard time of about 3 min. on this operation, using a stop-watch on a day worker, was reduced to 57 seconds *average* continuous time by a piecework "demonstrator."

The secrets of this operation from the operator's standpoint are:

1. Properly ground tools.
2. A quick, snappy whirl and tug at the end on the tail stock wheel to make the clamp and knurled plate grip the plate hard. If it slips, the knurled plate will mark the inside of the disc.
3. The proper pressure on the roller lever. If the roller is pulled in too hard, the edge of the plate will bend and curl over slightly, making for poor riveting and poorer appearance. Neither can a plate that has been "curled" on the edge in the circle shear trimming be properly rolled.

Similar notes were prepared for each operation. In case a manufactured article involved a large number of operations, instead of only a few, as in the case selected, a booklet would be prepared, with one or two lines only for each operation, merely summarizing by symbols information like the above, with reference numbers for the details.

The Straight Line Method

The study of the routing of material, the arrangement of machines and equipment, and the handling of material was given special consideration, and the work was planned for a continuous flow of material, following the "straight line method" of manufacturing. Lack of space forbids a description of the production records by operations, the graphic charts for watching and controlling the flow of materials according to the schedules, and other necessary adjuncts of planning and checking results.

The inspection of work after each operation is given particular attention, and although the central inspection system is not used on account of the simplicity of the manufacturing processes, once the equipment has been accurately designed, yet in other respects the inspection is very similar to that of the Bridgeport Rifle plant.

Planning Functions in Management

To summarize the practical methods of planning covered by this series of articles: We have limited our discussions to certain mechanisms of management which involve the planning functions as ordinarily understood. We have not included a number of the planning functions which may be performed by the central planning department, as described by Dr. Frederick W. Taylor in his wonderful paper read before the A. S. M. E. in June 1903 on "Shop Management," wherein he says that the leading functions of the planning department are as follows:

A. The complete analysis of all orders for machines or work taken by the company.

B. Time study for all work done by hand throughout the works, including that done in setting the work in machines, and all bench, vise work, and transportation, etc.

C. Time study for all operations done by the various machines.

D. The balance of all materials, raw materials, stores and finished parts, and the balance of the work ahead for each class of machines and workmen.

E. The analysis of all inquiries for new work received in the sales department and promises for time of delivery.

F. The cost of all items manufactured with complete expense analysis and complete monthly comparative cost and expense exhibits.

G. The pay department.

H. The Mnemonic Symbol System for identification of parts and for charges.

I. Information bureau.

J. Standards.

K. Maintenance of system and plant, and use of the tickler.

L. Messenger system and post-office delivery.

M. Employment bureau.

N. The shop disciplinarian.

O. A mutual accident insurance association.

P. Rush order department.

Q. Improvement of system or plant.

Although there can be no doubt but that functions G, K, L, M, N, O and Q should be performed by some competent person in each factory, yet the size and character of the plant and the type of organization which suits that plant may not of necessity require nor may it be possible to permit the planning department to perform them all.

Installation of Planning Methods

In our discussion of methods of planning, we have been more concerned with functions which are so frequently neglected, such as the proper setting of piece rates, complete "job analysis" of all orders, and the determination of the best sequence of operations, as well as with the continuous "flow of materials." It appears to me that the installation of proper planning methods in a plant unaccustomed to planning is more a matter of "salesmanship" than anything else. If you can only get some experienced, intelligent person to make a special and intensive study of each one of the leading functions which ought to be performed correctly, such as those mentioned above, and let those persons have an opportunity to study the relationship between all the elements involved, and then through some central agency, under a production manager, can coordinate all the information and efforts of these various specialists, you are very sure to arrive at the conclusion that practical planning pays, and that rule-of-thumb methods of management based on misinformation, hearsay, or guesswork and not on facts and knowledge, are the cause of most of our excessive costs and manufacturing troubles.

(Concluded in this issue.)

A Co-ordinated System of Planning, Routing, and Cost Accounting—I

By FREDERICK A. WALDRON

Consulting Engineer

Index Number

658.5 Production management

THE five main piers on which any manufacturing enterprise rests are *Engineering*, *Production*, *Inspection*, *Maintenance*, and *Accounting*.

These basic elements enter into the manufacture of all commodities no matter how simple. In the small factory all of these are functioned and performed by one man. His mind automatically assimilating and analyzing the various problems as a result of a gradually increasing business and years of accumulative experience.

When a business has reached proportions beyond the "one-man stage," the first steps of unloading occur and responsibility begins to be divided.

The natural and logical way, therefore, would be to classify such responsibilities by the normal requirements or elements enumerated above.

The most difficult obstacle encountered in any type of re-organization is the mental attitude. It is very hard for a reasonably successful man to let go of accrued habits or ideas after years of intimate contact with a product that has been his life's work, and oftentimes the supreme sacrifice is made at this altar, or business failure results.

The large number of moderate-sized factory building ruins are silent witnesses of this fact. On the other hand, the marvelous development and growth of American industries as a whole show the possibilities of achievement by a broad and scientific policy of extension and enlargement.

These functions or divisions which form the groundwork or foundation for industry will be treated in detail, outlining the intent and purpose of each beginning with the most important division.

The engineering division is in reality a bureau of design and technical information and should have as its chief a man of exceptional ability. He should be familiar with the design and construction of machinery, methods of manufacture, workmanship, and material specifications, and he should be a good organizer.

In filling this position it should be borne in mind that a low-salaried man is often expensive and a high-salaried man is often inexpensive in the long run.

The utmost care should be used in selecting a chief engineer as the basic efficiency of the organization rests on this division. Having selected a proper person, it is quite essential to inform him of his duties and the broader functions of his division, also the general outlines of the scope of his work. This division should perform in brief the functions shown on the chart of Fig. 1.

Too much cannot be said of the importance of the design of a product. It is in fact, the most important of all work in the corporate organization as it is of paramount importance that a product should not fail under use and that it can be made at a minimum cost with maximum quality.

Design should be interpreted to mean a full consideration, delineation, and

WORKS MANAGER

↓

CHIEF ENGINEER

↓

ENGINEERING DIVISION

↓

DESIGN	SPECIFICATION	STANDARDS	DRAFTING ROOM	TOOL ROOM	PATTERN SHOP	FORMS
(a) New Product. (b) Improvements. (c) Refinements. (d) Methods of Manufacture. (e) Buildings. (f) Equipment. (g) Estimates.	(a) Materials. (b) Machinery. (c) Workmanship. (d) Inspection	(a) Tolerances. (b) Gauges. (c) Workmanship. (d) Test'g Materials. (e) Products. (f) Tools. (g) Screws. Tapers. Cams. Stops, etc.	(a) Detail Dr'w'gs. (b) Tool Drawings. (c) Gauge Drawings. (d) Operation List. (e) Production List. (f) Factory Arr'ment. (g) Organiz'n Chart. (h) Flow Charts. (j) Symbol Charts. (k) Route Cards.	(a) Organization. (b) Equipment. (c) Tool Repairs. (d) Gauge Repairs. (e) Mach. Tool Record. (f) Jigs, Tools and Fixtures.	(a) Pattern Dr'w'gs. (b) Pattern Making. (c) Pattern Alter'ns. (d) Final Approval. (e) Checking.	(a) Design (b) Preparation (c) Approval (d) Symbols

NOTE: All of this Work Should be Done in Full Cooperation with Production, Inspection, Maintenance, Accounting and Sales Divisions with Final Recommendation on all Important Questions by Chief Engineer to Works Manager, who, after Receiving Executive Approval, issues Letters of Instruction or Authorization to the Division Chiefs.

FIG. 1 FUNCTIONAL OUTLINE OF THE WORK OF AN ENGINEERING DIVISION

DRAWING ROOM STANDING ORDER

Name Date

Description of Work

Folio

Book Page

Remarks

FIG. 2 DRAWING-ROOM STANDING ORDER FORM (3 x 5 IN.)

specification of all elements entering into the operation under use; also the economical manufacturing of the finished article. The thorough engineer will take all these items into account and produce a series of practical working drawings and specifications for shop use, and not a picture.

Specifications

Specifications should be clear and concise as well as giving the practical description of the work to be done and materials to be furnished. They should conform in so far as possible with the standard practice of the times. Special requirements should be avoided where possible, especially where materials are specified, in order to avoid excessive cost and obtain reasonable bids in the open market.

All specifications should have serial numbers and should be cross-indexed with subject and numbers. It is advisable to use 8½ by 11 in. letter-size paper rather than legal cap, as it admits of filing and mailing in letter-size cabinets and envelopes. Where many duplicates are required, "onion skin" paper will be found fairly tough and convenient.

Each sheet of a specification should have some identification mark, either by printed name of firm, seal stamp, or initials of chief engineer, in order to avoid possible change or substitution by unauthorized persons.

Standards

Interchangeability for all apparatus used in a factory is an element of basic economy and should be covered in specifications for new equipment and the interchanging of existing equipment.

Face plates and chucks should be interchangeable.
Toolholders made in as few sizes as possible.
Tapers made in as few sizes as possible.
Turret lathe tool shanks in as few sizes as possible.
Jig stops, cams, binding or clamp screws made in as few sizes as possible.
T-slot widths for planers, milling machines and grinders made all the same size.
Bolts, nuts, and screws should be listed and standardized.
Snap and plug gages.
Shafting and hangers.
Counter-shafts.

Tolerances should be given most careful attention, and as much latitude should be allowed as will admit of assembling and operating the finished product satisfactorily, remembering that costs decrease in proportion to the square of the tolerances.

The standard of workmanship and materials should be established by a description of finish, and materials

CHARGE TO 997

CARD ISSUED 19__ TO__

PRINT ISSUED 19__ TO__

DRAWING. TRACING PRINT 997 SIZE

19__

TITLE

CHARGE TO SUPERSEDING SUPERSEDED

NO. 19__ BY__

THIS CARD MUST ACCOMPANY THE DRAWING UNTIL IT IS APPROVED

CHARGE TO 998

DRAWING. TRACING. PRINT 998 SIZE

19__

TITLE

FIG. 3 SHEET NUMBER RECORD FOR DRAWINGS

These forms are arranged in blocks of four. Each block is 12¾ x 9¾ in. in size. The card which is to accompany the drawing is perforated so that it may be detached.

1. Profit and Loss ..... No Symbol.
2. Capital Account ..... No Symbol.
3. Betterments ..... M Symbol.
4. Expense ..... 10 to 90 by tens for General Expense.
5. " , Repairs ..... 16 to 96 by tens for Repairs to Machinery, Tools, Plant.
6. " , Sales ..... 5 to 95 by tens.
7. Administration ..... A Symbol.
8. Sales ..... B Symbol.
9. Manufacturing ..... G Symbol.
10. Commercial ..... C Symbol.
11. Jewelry ..... L Symbol.

SYMBOL C - COMMERCIAL DEPT.

SYMBOL E TRADE SEAL DIVISION			SYMBOL P NAME PLATE DIVISION			SYMBOL D ADVERTISING DIV.		NOVELTIES DIV.	
F	Y	N	F	Y	N	T	H	J	Q
Auto N.P.	Bic. N.P.	Furniture	Auto N.P.	Bic. N.P.	Furniture	Sh. Tags	No. Plates	Medals	Misc.

SYMBOL L - JEWELRY DEPT.

R DIV.	V DIV.	X DIV.	U DIV.	Z DIV.
Fraternity	Novelties	General	High School	Stationery

FIG. 4 A MASTER SYMBOL CHART FOR A JEWELRY FIRM

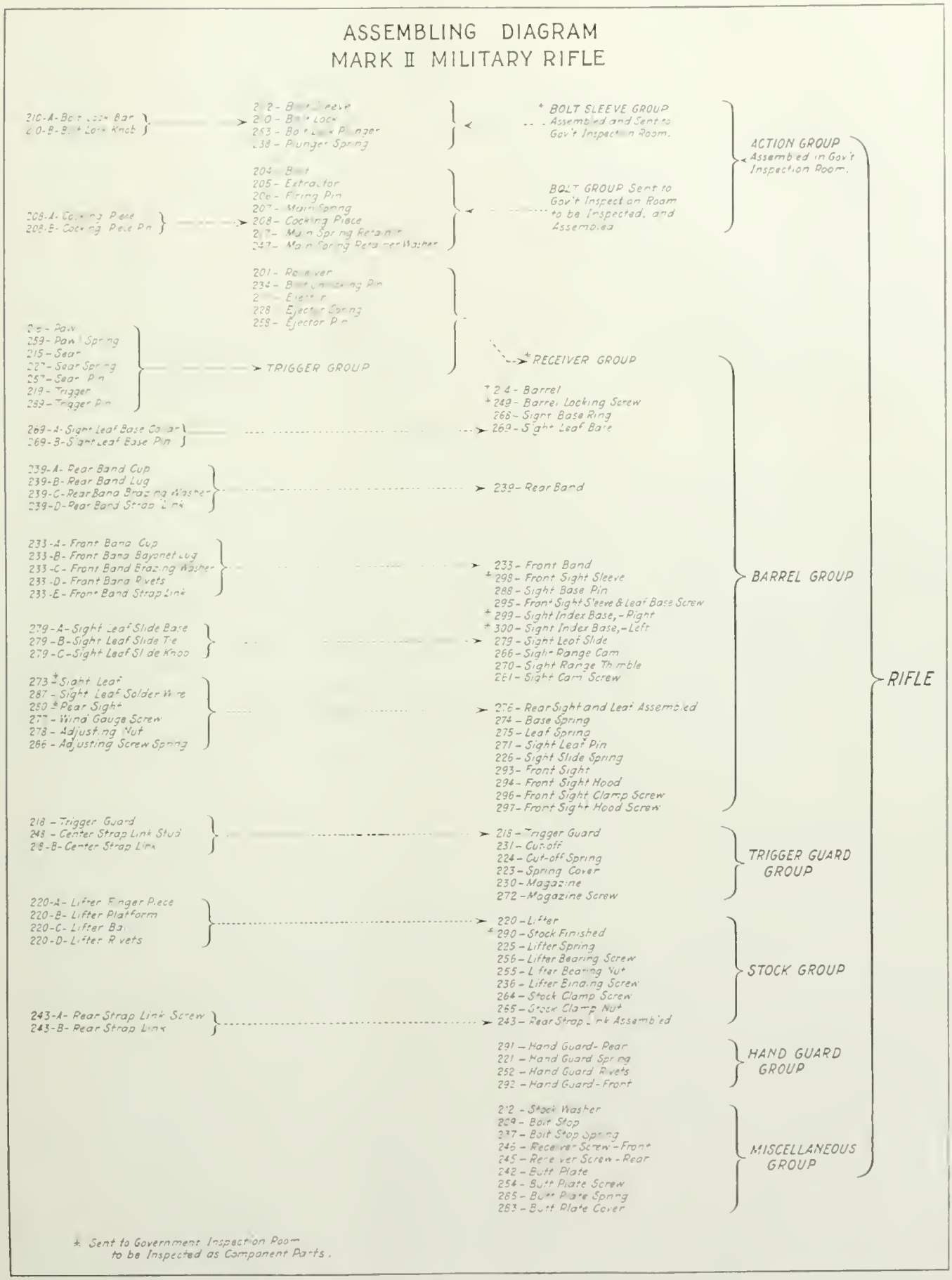

FIG. 5 FLOW DIAGRAM SHOWING THE ASSEMBLING OF A MILITARY RIFLE FROM THE INDIVIDUAL PARTS TO THE FINISHED ARM

Part No. _____ **ROUTE CARD**

Name _____

Date _____

OPER NO.	DESCRIPTION OF OPERATION	DEPT.	MACH. SYMBOL	T & I CARD

FIG. 6 MASTER ROUTE CARD FORM (5½ x 8½ IN.)

can be covered by specifications after the proper kind has been determined. No change in sources of supply should be made without approval of the chief engineer.

The drafting-room should be in charge of a competent chief draftsman either with or without full technical education. He must, however, be a good executive and capable of handling the work systematically upon designs being turned over to him for details.

Complete records of all drawings and changes thereon should be centered at this point.

A good way to handle a large drawing-room is by the standing order, Fig. 2. This order is made out when the sheet number is assigned by Fig. 3 and placed on a bulletin board of sufficient size to care for the current work. These forms, Figs. 2 and 3, remain on the board until the sheet is finished and filled in; they are then removed and filed by the chief draftsman.

Other functions of the drawing-room are given on the chart, Fig. 1; symbol and flow charts, Figs. 4 and 5; master route cards, Fig. 6, and general organization chart, Fig. 7, should also be prepared and kept up to date.

As the tool designing is a part of the work of the engineering division, it is quite logical that the manufacture of tools should be placed as closely as possible to this division.

The toolroom should be organized on a production basis and the same forms used for time tickets, standing order, inspection, and moving as are used in production division with the addition of Fig. 8; the card serving as an order, and the stub attached to the article to be repaired.

Its equipment should be complete and of a character to correspond with the accuracy of the work required. Care should be taken not to overdo this, as apparatus for precision work is very expensive.

Measuring standards, celeroscopes, surface plates, micrometers, and verniers of different types should be carried in sufficient quantity in order to avoid delays in output.

Heat treating and tempering should be controlled by the toolroom, as there is no phase of preparation so important in production as the proper tempering of cutting tools.

The specifications should cover carefully and fully the quality of steels used for cutting tools, and should be strictly adhered to.

All cutting tools should have sharpening standards and facilities for grinding rapidly and a full currency of these tools should be kept ready for use.

The technical supervision of the pattern shop should be in this division.

Interpretation and correction of drawings, special shrinkage, molding problems, and final inspection of patterns should be matters of consultation and references between this shop and the drawing-room.

As the engineering division has available the data

OPERATING ORGANIZATION

GENERAL MANAGER

EXECUTIVE COMMITTEE			TREASURER		SALES MANAGER		WORKS MANAGER						
ADMINISTRATIVE			ACCOUNTING		SALES		MANUFACTURING						
Gen'l Policies	Financial	Legal	Office	Shop	Outside	Orders	Purchasing	Engineering	Production	Inspection	Maintenance	Employment	Welfare
Budgets	Cash	Patents	Billing	Costs	Trade	Acknowledgment	Market	Drawing Room	Discipline	Products	Heating	Hiring All Help	Rest Rooms
New Products	Notes	Suits	Bookkeeping	Stores	Advertising	Information	Prices	Tools	Operation	Tools	Power	App. for Employm't	Lunch Room
New Policies	Insurance	Accidents	Correspondence	Time	Competition	Entering Orders	Supply	Jigs	Product. Dept.	Machinery	Lighting	Record Employees	Social Activities
Org'n Changes	Ins. & Taxes	Income Tax	Auditing	Pay Roll	Commission	Shipping Orders	Orders for Mat'ls.	Fixtures	Routing	Buildings	Furnaces		
	Discounts	State Law	Payment of Bills		Salesmen		Follow up	Dies	Machine Hours	Safety	Wiring		
	Collections	City Law	Collections		Correspondence		Mat'l. Deliver	Pattern	Time	Fire	Shafting		
	Profit & Loss	Insurance					Freight Rates	Route Card		Accident	Motors		
	Property	Corporat'n Law					Express Rates	Operating Lists			Misc. Equipm't		
	Budgets							Methods					
								Time Study					
								Estimating					

FIG. 7 A TYPICAL OPERATING ORGANIZATION CHART COVERING THE ADMINISTRATIVE, ACCOUNTING, SALES AND MANUFACTURING FUNCTIONS

TOOL AND FIXTURE REPAIR CARD

ORDER NO. _____ CH'GE NO. _____ DATE _____

WORKMAN _____

SUBJECT _____

GIVEN OUT _____ WHEN WANTED _____

COMPLETED _____ INSPECTED _____

ORD. NO. _____

CHG. NO. _____

FIG. 8 TOOL AND FIXTURE REPAIR FORM (6¼ x 3¼ IN.)

and is in a position to judge as to the necessity and design of the forms used, it should be the logical place to design and maintain the standard. This does not mean that the accounting or production division may not suggest or require, or design such forms as may be needed. Such forms should be approved by the chief engineer or works manager before printing is authorized.

In conclusion it should be borne in mind that when responsibilities are irrevocably fixed, the human element is bound to be at its best, as it becomes a matter of individual self-preservation. Under such conditions each individual is bound to work harder and more efficiently than when the opportunity to "pass the buck" is wide open.

The engineering division should, when properly managed, place in the hands of the producing and inspection division all the necessary information economically and quickly to perform all work necessary to give a completed product of maximum quality. When the scope of a business is limited, the functions of this division can be combined with any one of the other divisions excepting the accounting division.

Flow Charts (Fig. 5)

Flow charts are, when properly designed and used, one of the most important factors of systematic production and should contain every item used in the completed product. The flow chart is in fact the "road map" for every part, and a reference chart for the progress and classification of all work.

The detail information brought to the surface, even in making up a perfect flow chart, develops many points that have been overlooked. As a guide to assembling, symbolizing, and routing work, it is indispensable. It can also be used as a check list in completing shipments, and is a convenient reference in making up costs.

(To be continued in the February issue.)

Strange Uses of Common Materials—II

By EDWARD R. WEIDLEIN

Director of the Mellon Institute of Industrial Research of the University of Pittsburgh

Index Number
66 Chemical technology
658.57 Industrial research

CARBON dioxide, on account of its properties, has found its way into many curious uses. As a convenient source of gas under pressure it is used for operating outlying railway signals, as a motive power for torpedoes, for inflating automobile tires, for blowing obstructions out of plumbing, and it is even recorded that, before the gasoline engine had been perfected, a German inventor made and caused to fly a small airplane driven by a motor that derived its power from the escape of liquefied carbon dioxide.

Action of Carbon Dioxide

Now when carbon dioxide expands from the pressure in the commercial cylinders to the pressure of the outside air, it is cooled, and a part of it becomes frozen in the form of snow, which has a temperature below −100 deg. fahr., and this is the basis of many strange uses. For example, rubber may be frozen by bringing it into contact with this snow until it becomes a brittle, easily pulverized solid, and this is the basis of one method of preparing rubber samples in finely divided form for chemical analysis. Molded into pencils, the snow has been used by physicians to produce local freezing of portions of the skin, in order to facilitate the removal of blemishes. The liquid carbon dioxide itself is used as the refrigerating liquid in mechanical refrigerating machines, especially where low temperatures must be reached, as in the manufacture of helium, and where safety is important; for should the refrigerant escape from the machine, it could poison none and, far from burning, would extinguish any fire in the vicinity.

Many uses are based upon the non-combustible nature of carbon dioxide. Large electric generators have been equipped with carbon dioxide fire extinguishers, and a part of the telephone system in the United States uses "gas" fire extinguishers which are charged with pure carbon dioxide. It has been successfully applied to extinguishing fires on shipboard, and recently a large coal mine has been effectively "gassed" to extinguish a fire.

Carbon dioxide has been found to have beneficial effects upon various food products, so that now there may be purchased butter that has been churned in it, ice-cream that has been frozen in atmosphere of the gas, and cocoanut and other products which come in tin cans full of carbon dioxide.

Acetylene in the Manufacture of Chemicals

Acetylene is a well-known chemical compound because of its extensive use as an illuminant and for metal welding and cutting purposes; but it is not generally known that this gas is the starting material for the synthetic preparation of many compounds previously prepared from wood, coal, etc., by such processes as fermentation, distillation and "cracking". The four main divisions under which these synthetic products may be classified will be considered briefly.

Chlorination Products. Chlorine gas and acetylene may be combined to form a whole series of products which find use as solvents, replacing in many industries those commonly used previously, such as benzine, gasoline, solvent naphtha, etc. Each of these chlorinated solvents has specific properties of its own that make it applicable to the industry where it is now finding use.

Most prominent among them is acetylene tetrachloride, used as a solvent for cellulose esters, rubber, resins, fats, etc. It is also a good fire extinguisher. Next in line is triclor-ethylene, which is finding favorable application in the oil-extraction industry. Pentachlor-ethane is likewise being used as a solvent in the cellulose ester industry, while the fully chlorinated hexachlor-ethane is a solid and serves as a camphor substitute. These chlorinated compounds are all non-inflammable, which accounts to a large degree for the rapidly increasing use of them industrially.

Ethyl Alcohol and Its Products

Hydration Compounds: Acetaldehyde. One of the most important chemical reactions of today, from a commercial point of view, is that brought about when acetylene gas is passed through an acid solution of water containing a small amount of a mercury salt, whereby acetaldehyde is formed. This product is the starting point for the synthetic preparation of many useful and valuable commodities, such as acetic acid and its many derivatives, ethyl alcohol and products from it, paraldehyde, aldol, metaldehyde, etc.

Hydrogenation Products. By passing acetylene and hydrogen together over certain metals heated to a suitable degree the hydrogen can be made to combine with the acetylene, to form the hydrocarbon gases ethylene and ethane. Ethane is finding application as a refrigerant; it is also being used as a high-grade fuel.

Ethylene is a very important derivative of acetylene, being applicable as an illuminant and, to a limited extent, as a heating gas for cutting purposes and in welding. For preparing synthetic organic chemicals ethylene is beginning to play an important rôle.

Basis of Printing Ink

Decomposition Products. Users of acetylene have no doubt observed that it burns in an insufficient amount of air to produce voluminous amounts of "soot". This material, called "acetylene black," where manufactured under proper conditions, forms a product which is a very suitable component of printing ink, as well as a filler in rubber manufacture.

Among other reactions of acetylene, the synthetic production of benzene and carbolic acid are important. The greater part of the rapid advance in the production of synthetic organic compounds from acetylene came during the war, when insufficient supplies of chemicals made by other processes necessitated new means to manufacture these chemicals. With the field thus opened up, research and industrial prospects in acetylene applications are exceedingly promising.

Colloid chemistry, which deals with bubbles, drops, grains, filaments, and films, and is, in fact, the chemistry of everyday life, is replete with illustrations of strange uses of common substances.

Charcoal is used in most gas masks, because it is the most satisfactory general absorbent for poisonous gases. It is also applied as a means of getting a high vacuum and for obtaining the rare gases krypton and xenon from the air. Its use for the sorption of gasoline from natural gas is of industrial importance.

The action of protecting films is interesting. The addition of gypsum produces a retarding effect on the rate of setting of Portland cement. Corn starch—potato starch will not do—is used to protect calcium (lime) phosphate from moisture in phosphate baking powders.

Foams are of great utility. Froth produced usually by pine or mineral oil is the basis of the well-known flotation process for separating ore from gangue. A carbon dioxide froth, made from alum, or an acid, sodium bicarbonate, and glue, and stabilized by the addition of ordinary licorice, is used for extinguishing fires, especially of petroleum in tanks.

In the glass industry colloidal solutions are quite common, with gold, copper, and stannic (tin) oxide as the dispersed phase, or color. Fused glass containing a small amount of gold is colorless and remains colorless if cooled quickly. If cooled slowly, or if reheated to a temperature well below the melting-point, it becomes red, owing to the separation of particles of gold of the size to transmit red light. One-tenth of one per cent of gold gives a red color.

Soap as a Chemical Agent

The use of soap in "breaking" oil-field emulsions is of technical importance. During the drilling for crude petroleum infiltration of water occurs, and water-in-oil emulsions of varying degrees of stability are produced by the emulsification of the water in oil. The larger globules of water eventually settle out, but the more minute globules remain in suspension and are removed by suitable chemical or physical treatment. Chemical methods for the de-emulsification of crude petroleum emulsions have found extensive application. Water-soluble soap is a common agent and sodium oleate is the basis of several patented compounds. Soda ash, glue, and starch are other ordinary substances which are used for "breaking" crude oil emulsions.

Casein, an edible product of good food value, which is familiar as the chief nitrogenous constituent of milk, has come into general use as a structural material. It is separated from skimmed milk by coagulation with rennet or an acid.

Treated with formaldehyde, casein yields the plastic "galalith," or "lactolite," which is used to make a large variety of pressed and molded articles—buttons, handles, disks, etc. Casein cement, which came into prominence during the World War in airplane construction, is a strong, waterproof binder for wood. It is made of lime, sodium, fluoride, and casein.

"Bakelite" and "Redmanol"

The important plastics, "bakelite" and "redmanol," are also manufactured from common substances, viz., carbolic acid and formaldehyde. They are produced by the combination ("condensation") of these two chemicals in the presence of an alkaline agent.

Several forms of these plastics may be prepared and they are now in wide use as varnishes, insulators, ivory and amber substitutes, etc. They may be filled and colored for use in making an endless variety of articles—beads, buttons, balls, disks, and the like.

The Rise of "Industrial Democracy"*

VII—"The Organization of Modern Industry"

By DEXTER S. KIMBALL

Dean, College of Engineering, Cornell University

Index Number
658.16 Organization of industry
658.3151 Co-operative management

WE often fail to realize that words and phrases may be fearsome things that carry broadcast ideas and ideals that may be fraught with good or ill for the human race. Thus Mr. Wilson's suggestion of the "self determination of nations," while without doubt containing the germ of a great reform, would, if applied literally to India, drench that troubled land with blood; and the same remarks hold true for other parts of this planet. The term "welfare work," for so long a catch-word in industry, was found also to be a dangerous suggestion unless its scope and intention are carefully defined. And so it is with "industrial democracy". Containing, no doubt, the essence of a result greatly to be desired, it may, unless properly understood and delimited, lead us into deeper industrial difficulties. Already, because of the prominence the expression has received, there are many people who have the idea that some great, new principle of industrial management has been born into the world, whereby large enterprises can be managed in a perfectly democratic manner, where all employees will have an equal share in the management, and where all the defects of modern management as it now exists can be eliminated. And there are not wanting prophets of the idea represented by this new slogan who tell us that here at last is the solution of the great problem. It may be of interest to investigate what industrial democracy is, whence it comes, what its limitations are, and how its ideas square with the preceding discussion.

Separation of Mechanic Arts and Agriculture

The net effects of the industrial revolution have been to complete the separation of agriculture and the mechanic arts and to develop transportation to serve these fields of activity. In transportation and mechanic arts ownership of the tools of industry has, to a large degree, passed out of the hands of the actual worker and is now under capitalistic control. In these fields, also, division of labor has been extended to an amazing extent. These changes have tended naturally to widen the gap between the employer and the employee, and to make the latter more and more dependent upon the former for his means of livelihood. The old social order has been broken up and the old friendly relations that formerly existed between master and man have been destroyed, and nothing has been provided, as yet, that in a broad way replaces these losses.

These tendencies have been hastened, naturally, by the growth in the size of individual industries. The larger the plant the farther the distance between the management and the worker, the gap between being filled with the machinery of organization, that was described in the last article.[1] And no doubt these changes have been intensified by the great influx of low-paid immigrant labor that has for many years flocked to our shores and found ready employment in the great mass-production industries. The introduction of these workers erected new barriers of *race* and *language* between management and men, and no doubt this tide of immigration has done much to accent the false ideas that there are two kinds of people in the industrial world, those who work *for* money and those who work *with* money.

Production Easy, Distribution Difficult

The creation of these many industrial classes with their conflicting interests has already made our civilization much more complex than any that has ever existed, and the end of this tendency is not as yet in view. The time-old question of "what is mine, and what is thine" is more difficult to answer than ever before. We thus find ourselves increasingly able to produce the comforts and luxuries of life and decreasingly able to distribute them to the satisfaction of all. We have developed our powers of production vastly beyond our knowledge of equitable distribution. It cannot be denied, of course, that this great increase of productive power has benefited all, both brain worker and manual worker. Never before in the history of the race has the average level of well-being been as high as it is in America today. But well-being is a relative term, and with increasing power of production has come an increasing demand that the fruits of industry shall be more equitably divided, or, rather, divided in a different ratio since it is difficult to say just what an equitable division may be.

The reasons for industrial discontent are many and are deep-rooted. First there is the ancient contrast between the very rich and the very poor which is so great today as to cause even some of those who have great wealth to ponder the desirability of such great extremes. A great contributing cause no doubt is found in the utter dependence, of those who labor, upon or-

* Preceding articles have appeared in MANAGEMENT AND ADMINISTRATION, July 1923, p. 17; August 1923, p. 165; September 1923, p. 333; October 1923, p. 437; November 1923, p. 599; December 1923, p. 743.

[1] See MANAGEMENT AND ADMINISTRATION, December 1923, p. 743.

ganized industry and capitalistic control, due to the complete separation of the worker from the ownership of the tools of industry. A minor, but important cause, is the lack of opportunity on the part of the worker to take a more intelligent part in industry because division of labor chains him to the production of a small part, and cuts off a visualization of the industry as a whole. In other words, the worker to a large degree can no longer "express" himself as in the old handicraft industry.

Rising Tide of "Democratic" Ideals

More potent than these is the rising tide of modern democratic ideals that increasingly insists that industry shall be considered less as a personal matter and more as a general support of life, and that personal profit and advantage shall be secondary to the general weal, or as it is sometimes stated that industry shall be "democratized". Our ideas of democracy in industry will be governed, therefore, largely by our interpretation of this democratic movement; and within the group that is pressing for this democratization a wide variation of opinion will be found and many panaceas are offered for our industrial ills.

Thus one group preaches the doctrine of anarchy which holds that all law and government are an evil and could be dispensed with. For the most part this belief has never gone beyond the realm of speculative philosophy. Another much larger and more important group holds as a basic tenet the need of restoring to the worker the ownership of the tools of industry. This is the tap root of all socialistic doctrine though the advocates of socialism differ widely in their ideas as to the degree to which it is necessary or possible to bring about this result. In its most violent form this group would destroy modern industrialism with no adequate substitute to replace it. This has been almost accomplished in Russia where the extreme view obtained that the ownership of the tools of industry should be vested in those who actually produce. The brief but dreadful experience of that unhappy land has proved beyond doubt what every student of organized government already knew. *No organized industry that is capable of supporting a modern civilization can be successfully operated by manual labor alone.* The industrial manager, the functionalized worker or specialist, and the financier are as necessary to modern industry as the actual worker no matter how skilful he may be.

Difficulties in Co-operative Ownership

It should be carefully noted that there is nothing in the laws or public sentiment of this land that prohibits, in any way, the joint ownership of productive tools by any group of men in any number. Furthermore, there is no prohibition of any kind that would prevent such a group from operating such tools in the most democratic manner they may choose to elect or devise. The history of such co-operative efforts except where those involved have been held together by some extraneous bond, such as religion, has been, for the most part, a story of failure. While, therefore, these socialistic doctrines have exercised and are exercising a powerful modifying influence upon capitalistic industry they are not likely to be accepted, in the near future at least, as the controlling principles in industrial management. The widespread lack of thrift among present-day workers, and their lack of special knowledge and training in industry and finance will, unless our educational processes work a great change, long remain a great obstacle to co-operative ownership and control of the most democratic kind.

Recognizing, perhaps, these limitations of socialistic doctrines, some industrial reformers have turned to the principle of government by representation as illustrated in our national government and similar institutions elsewhere. In theory, at least, this form of control is rational and fair. It recognizes that civilization requires many men of many minds; and through the election of those best fitted to represent the varied and conflicting interests of the country, it aims to confer the greatest good upon the greatest number.

Intelligence Needed for Representative Government

Some of the basic reasons why we have not obtained better results with representative government should be noted in connection with its application to industrial management. First there is a general lack of knowledge on the part of the populace of many of the most important issues of government, and there is always a lack of intelligent leaders who are of the people and for the people. Democracy is blind in many respects and "where there is no vision the people perish". Because of this weakness, also, the aims of representative government are often defeated by minority groups who are interested in movements looking to their own selfish aims, and who through skilful propaganda and the voices of demagogues influence the popular vote in their own interest. Whether we shall be able to overcome this difficulty by universal education, as many hope we shall, remains an open question.

Despite these limitations, however, representative government as existing in this country is in many ways the best form of government, for our ideas of civilization, that has as yet been devised. It was quite natural, therefore, that an effort should be made to apply its essential features to industrial management in answer to this demand for democratization. For some time prior to the great war forward-looking employers, and employees who wished to obtain a more adequate means of presenting their desires had in a number of instances organized joint committees of various kinds in an effort to reach a better mutual understanding. The labor difficulties incident to the war gave a considerable impetus to this movement, both the National War Labor Board and The Shipbuilding Labor Adjustment Board, not only encouraging the formation of joint committees of workers and employers for the discussion of industrial problems but, in some instances, insisting that such agencies be employed.

A report on this subject, by the National Industrial Conference Board in 1919, states that 225 such "works councils," as the report designates them, had been organized since January 1918. A supplementary report published in 1920 states that the number of works coun-

cils which were then in force was upwards of 700.

It will be obvious that from the very diversity of industry itself these works councils must necessarily vary widely in character and scope. They have, however, one important common feature, namely, they are all based upon representation chosen by and from the employees of an individual enterprise. Otherwise, they vary in size, scope, method of formation, and other specific features of organization. In small plants the works councils are of the simplest and most informal type, while in some of the larger enterprises they are very formal and quite complex.

For convenience of discussion all works councils may be divided into two general types. The first type includes those organizations that are modeled after the federal government and is, therefore, known generally as "Industrial Democracy". The chief sponsor of this method of employee representation is John Leitch who defines this method as:

> The organization of any factory or other business institution into a little democratic state with a representative government which shall have both the legislative and executive phases.

The "Industrial Democracy" Plan

In this plan there is first a "cabinet" consisting of the executive officers of the plant. This body is not elective but owes its existence to the ownership of the enterprise. The cabinet holds a veto power over legislation, but it may suggest measures to the "senate" and "house of representatives". The senate consists of foremen and department heads and usually is not an elective body, though in one instance, in a very large plant, this body is also elected by the employees from the ranks of the foremen and departmental heads. Lastly, there is the house of representatives which is elected by secret ballot by the actual workers in the institution on such a basis as may seem most desirable. These bodies are organized with the same general legislative machinery, committees, etc., as the federal government, and are expected to transact business in a manner similar to that organization. As a basis of action and as a bond to hold the work of the several bodies in harmony there is a written "Business Policy" corresponding to the Constitution of the United States and containing a declaration of principles and reasons why the organization has been called into being.

The basic intent of this form of organization is to provide an opportunity for the workmen to express their views on all matters in which they are competent to do so. Bills or measures may originate in the senate or house but they must pass both house and senate and be approved by the cabinet before becoming a "law" or shop regulation. Undoubtedly such a plan will provide the opportunity for a free exchange of opinions on many phases of industrial management, and no doubt shop rules and regulations formulated thus by the aid and with the consent of the workers will be far more satisfactory than if imposed from above. If founded in a liberal spirit the deliberations of the house will, no doubt, bring many needed changes and grievances to the attention of the management and assist materially in obtaining a better understanding of the things that make for content and confidence in the management. Obviously, such a comprehensive plan as outlined in the foregoing is best adapted to plants of some magnitude.

Defects of the "Industrial Democracy" Plan

One of the greatest defects of industrial democracy, so-called, in the opinion of the writer, is the fact that the representatives of the workers meet by themselves in one body, and the representatives of management meet by themselves in two other bodies. While it may be possible that such an arrangement is conducive to a greater freedom of speech on the part of the workmen it does not tend to restore in any great measure the old *personal contact* that has been lost in the great growth of modern industry. The intercourse between the management and the workers is necessarily quite formal. Of course in the hands of an enthusiastic and able man like Mr. Leitch, or any industrial leader who can arouse and hold the loyalty of his workmen, any plan can be made helpful but, in the abstract, this lack of close personal contact in any way between management and men is a disadvantage at least.

For this reason the writer is inclined to believe that there is much more hope of securing better industrial relations through the second type of works councils which is based upon the committee system described briefly in the preceding article of this series.[2] It will be obvious that the committee system offers a wide range of joint activity. Thus the works council may consist of a single committee or there may be a number of committees arranged in ascending order of importance and authority, or there may be a number of unrelated committees each having jurisdiction over some special field. Again, these committees may consist wholly of employees or of executives as in the plan of industrial democracy, or they may be joint committees of employees and executives.

It is this last form of committee system that probably holds out most hope since this form of council offers more opportunity for personal contact between employer and employee than any other. Any detailed account of the many variations of the committee method that have been tried, or of the many now in operation is beyond the limits of this paper. Three points should be noticed, however. In all cases it is necessary to have definite plans for securing fair and satisfactory elections, the method of procedure must be clearly defined as must be, also, the function and authority of all committees. In a number of instances these matters have been worked out with considerable care.

The Problem of Fixing Authority

Of course the most important and most difficult phase of all organizations of this kind is to fix the function and authority of the committee or committees. It is in this connection that the limitations of democratic government appear most strongly. It is almost obvious

[2] See MANAGEMENT AND ADMINISTRATION, December 1923, p. 743.

that the deliberations of a body such as the "house" in the plan of industrial democracy or of a corresponding committee, under the committee system, must necessarily be confined to the field of *human relations*. Such a body is fully competent to discuss working conditions, shop rules, wages, hours of work, and kindred matters, but there appears to be definite limits to its usefulness in other directions. A report of the National Industrial Conference Board discussing the matter states:

> It appears from the foregoing that practically all works councils deal with such subjects of bargaining as hours of work, wages, and piece rates. In addition many such organizations concern themselves with the social and recreational life of the workers and with their living and working conditions. In some cases the works councils deal with shop discipline or with hiring, promotion, and dismissals, but usually by way of review and recommendation only. Relatively few works councils concern themselves with the improvement of production or with general management problems.

This last statement is very significant and indicates the direction of possible growth and development of such systems. It indicates clearly, also, the basic truth that *special knowledge and intelligence is not an elective faculty*. Important as these matters are that come within the scope of elected committees, they constitute only a portion of the problems of management. They do not touch the complicated problems of financing the enterprise, deciding upon what shall be manufactured, nor any of the difficult problems met with in devising and furnishing ways and means, purchasing material, and directing the general business activities. These functions require *specialized knowledge* which, as before stated, is not an elective possibility. If, from any industrial enterprise, there should be taken away the small body of specialists such as the financier, the chemist, the engineer, and those who understand modern industrial methods the entire fabric would collapse in exactly the same manner as did Russian industry when this class of men was eliminated.

The Worker's Knowledge

There is, nevertheless, an immense amount of industrial knowledge in the possession of any group of skilled workers that under ordinary methods of management is largely lost. The joint committee offers a means of co-operative effort that will make this practical knowledge of use, and many such committees are in operation. Thus a committee consisting of the designing engineer, the toolmaker, the purchasing agent, and a man from the shop who is fully acquainted with the processes involved can often do remarkable things in the way of reducing manufacturing costs. And the better personal understanding that comes from such conferences should be considered in no way as a by-product. The committee principle, in fact, can be applied to a very wide range of activities.

In a few instances an attempt has been made to secure a more democratic control by permitting the workers to elect representatives to sit with the managing directors and other administrative and executive bodies. While such representation may, if wisely organized, tend to a much better mutual understanding between employer and employee in that it may remove any mystery surrounding the administrative methods and assure the workers that they are getting their share of the profits, the limitations described in the foregoing hold true. In general, workmen are not prepared to assume administrative duties and less prepared to give intelligent decision on matters requiring special knowledge. We recognize this shortcoming in a broad way in the provision whereby we elect congressmen and senators, but rely upon the president to appoint the specialists who make up the cabinet. It is this limitation that makes co-operative efforts of all kinds difficult, and refined socialistic ideas a dream.

Movement Still an Experiment

Actual experience with representative government in industrial management has been far too limited to permit of any very definite conclusions as to the permanent value of the movement. Many questions as to the best procedure to be followed in operating works councils still remain vague and undetermined. Thus while the field of activity of such councils appears to be fairly well delimited the degree of responsibility and authority with which they may be invested is far from settled. No doubt this will vary widely with circumstances. In some plans, for instance, final settlement of a disputed point over which the council cannot agree is vested in the higher officials of the enterprise.

In a few cases compulsory arbitration by a disinterested party is provided for, while in many more no provision whatever is made for the final disposition of such an unsettled point if the works council, whatever its form may be, fails to settle it to the satisfaction of all concerned. Clearly we shall need much more experience with the idea before its possibilities and limitations are fully determined. We shall need to know much more concerning the relations between co-operative effort of this kind and financial incentives for increased productivity. And the relation of works councils to trade unionism cannot be overlooked in evaluating the possibilities of the former.

It should be remembered, furthermore, that many of these works councils were formed hastily under the stress of war, and it is not to be wondered at that a number have ceased to function. In many other instances, no doubt, they have been instituted without proper knowledge of their functions and with disregard of important details of procedure. There is considerable evidence, however, that a large proportion of employers and employees who have had experience with works councils have been favorably impressed.

The Worth of the Underlying Principle

The most important consideration, however, in connection with works councils is not the particular method of their formation nor even their powers and jurisdiction. The main question is whether this *principle* offers a means of securing a better understanding between employer and employee. If the principle is sound the

TABLE I DISTRIBUTION OF MANAGEMENT FUNCTIONS IN 181 PLANS FOR EMPLOYEE REPRESENTATION[1]

KEY TO ABBREVIATIONS

M = Management *E* = Employees *J* = Joint committee management and employees. *A* = Arbitration. Dashes show order of procedure from left to right. Parentheses indicate consultation with body represented by the appropriate letter.

COMPANY	Wages and Hours	Working Conditions	Discipline and Discharge	Efficiency	Managerial and Business Policies	Profit-Sharing and Other Financial Schemes	Adjustment of Grievances	Service Activities	Final Decision
Knox Hat Co	M	M	M	M	M		J	J	M—A
Lafayette R. Plumb, Inc.	M	J	E+M	M	M		J		J
Durham Hosiery Mills	M	M	M		M		J		M
Bethlehem Steel Corp	J	J	E+M	E+M	M	M	E—J—M	E+M	M—A
Colorado Fuel & Iron Co	J	J	E+M	J M	M		J	J	J—A
Jacob L. Decker & Sons	J	J	M	M	M		J—M	E+M	M—A
Procter & Gamble	J	M	M (E)	M (E)	M+E	J	J—M	J	M
International Harvester Co	J	J	M (E)	M	M		J	J	J—A
Peoples Gas, Light, & Coke Co	J	J	J	M	M+J		J—M—	J	M—A
Commonwealth Edison Co.	J	J	J	M	M		J—M	J	M—A
Standard Oil Co., Indiana	M (E)	M (E	M	M	M		J	M	—A
S. F. Bowser & Co	J	J	J	J	M		J	(J M	J (3E) 2M
Youngstown Sheet & Tube Co	J	J	E+M	E+M	M		E—J—M	E+M	M—A
Midvale Steel & Ordnance Co	E+M	E+M	E+M	M	M		J—M	M	A
General Electric Co., Lynn,	J	J	M	M	M		J	M	M
Loyal Legion of Loggers & Lumbermen	J	J	J	J	M		J	J	J—A
Inland Steel Co	J	J	J	J	M		J	J	J—A
Irving Pittsburg Co	E	E	E	E	M		E	E	E
Penn. Rapid Transit Co.	J	J	J	J	M	J	J	J	J—A
Bethlehem Shipbuilding Corp	J	J	J	J	M		J	J	J
James S. Fuller, Inc	J	J	J	M	M		J	J	J—A
100 Bridgeport Mfgrs.	M	J	J	J	M		J	M	M
Columbia Graphophone Mfg. Co	M	J	J	J	M		J	M	M
Willys-Overland Co. (Toledo)	J	J	J	J	M	J	J	J	M
Greenfield Tap & Die Corp	J	J	J	J	M		J		J—A
Leeds & Northrup Co.	M	M	M	M	M		J—M		M
Sidney Blumenthal & Co.	J	J	J	J	M	M	J	J	M
Reliable Stove Co.	J	J	J	J	M		J	J	M—A
Joseph & Feiss Co	J	J	J	J	M	J	J	J	J
B. Edmund David, Inc.	J	J	J	J	M	M	J	M	M
American Multigraph Co	E+M	E+M	E+M	E+M	M		J—M	E+M	M
Hydraulic Steel Co.	M	M	M	M	M				
Dutchess Mfg. Co	J	J	J	J	M+IF	J	J	E	J+IA
American-La France Fire Engine Co	E+M	E+M	E+M	M	M		J	M	M
Shepard Stores	M	M+E	M	M	M	M	J	M	M
American Pulley Co.	M+ (E	M+ E	M	M	M		J	M	M
Autographic Register Co	J	J	J	J	M		J	J	J+A
E. I. du Pont de Nemours Co. Dye Works	J	J	J	M	M		J		M
American Multigraph Co	J	J	J	J	M		J	J	M
Rhode Island Arsenal	J	J	J	M	M		J		M—A
Standard Oil Co., N. J	J	J	J	J	M	M	J	J	M
White Motor Co	J	J	J	J	M		J	J	M
Wm. Demuth & Co	J	J	J	M	M	M	J	M	M
Goodyear Tire & Rubber Co	J	J	J	J	M	M	J	J	M
Sprague Electric Works	J	J	J	J	M		J	J	M
Art in Buttons, Inc	M	J	M	M	M		J	J	M
James Hunter Machine Co	J	J	J	J	M		J	J	M
Gilbert & Barker Mfg. Co.	J	J	J	M			J	M	M
Dennison Mfg. Co	J	J	J	M			J		M—A
Walworth Mfg. Co.	J	J	M	M	M		J		M
Hale Bros., Inc.	J	J	J	M	M		J		M—A
Swift & Co	J	J	M	M	M		J	J	J
Hart, Schaffner & Marx	J	J	J	J	M		J	M	J+A
Elgin Natl. Watch Co	J	J	M	M	M		J	J	M
Phila. Rapid Transit Co	J	J	J	J	M	J	J	J	J+A
Miller Lock Co	M	J	M	M	M	J	J	J	M
Areo Co. (Cleveland)	J	J	J	J	M	J	J	J	J
Berkey & Gay Furniture Co	J	J	J	J	M		J		J (M)
Printz-Biederman Co	J	J	J	J	M		J		M
Riverside & Dan River Cotton Mills, Inc	J	J	J	J	M	J	J	J	J (M)
Lake Torpedo Boat Co	J	J	J	J	M		J	J	M
Wolverine Brass Works	M	J	M	M	M		M	J	M
American Rolling Mill Co	M	J	M	M	M		J	M	M
LaCrosse Plow Co., Inc	J	J	J	J	M		J		(IE—M)
Acme Wire Co.	J	J	M	M	M		J	M	M
Brooning Co	J	J	M	J	M	M	J	M	M
Yale & Towne Mfg. Co	J	J	J	J	M		J		M
Everlastik, Inc.	M	J	M	M	M		J		M
Plimpton Press	M	J	M	M	M		J	M	M
Virginia Bridge & Iron Co	J	J	M	M	M		J	M	M
Hickey-Freeman Co	J	J	J	M	M		J	M	J—A
Davis Coal & Coke Co	J	J	M	M	M		J	M	J—A
Timken-Detroit Axle Co.	J	J	J	J	M		J	J	J—A
Wayne Knitting Mills	J	J	J	J	M	M	J	M	M
Hercules Powder Co	J	J	J	M	M		J	M	M
Westinghouse Electric Mfg Co.	J	J	M	M	M		J	M	M
Armour & Co.	J	J	M	M	M		J	J	J
McCallum Hosiery Co	J	J	M	M	M		J		M
Pennsylvania System	J	J	M	M	M		J		M
Brooklyn Rapid Transit System	J	J	M	M	M		J		M
Traub Mfg. Co.	J	J	J	J	M		J	J	M

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best method of procedure is sure to be evolved. The history of welfare work so-called is filled with the records of misunderstandings and failures. Yet out of this movement have come certain basic principles and practices affecting working conditions in industry that today no thinking man questions. Aside from any humanistic motives it has been demonstrated that plenty of sunlight, air, and comfortable and sanitary surroundings are good business investments. We are in need of a similar movement that will assist in evaluating these more intangible and more important human relations.

Most industrial troubles have their origin in *distrust*, and distrust usually has its roots in *selfishness*. It would appear that there must be some form of joint activity that will enable capital and labor to sit down together and, setting both of these darksome human characteristics aside, arrive at a decision on any debatable matter that will be acceptable to both sides. Perhaps works councils offer this opportunity, at least they appear to hold a principle that is well worthy of careful consideration.

THE fundamental importance of a knowledge of the economic principles of industry to anyone in contact with manufacturing or industrial operation has been emphasized throughout the series of articles written by Dean Kimball, of which the one above is the final instalment. The treatment throughout these papers has been intensely practical with illustrative matter from fresh sources. Another helpful approach is from the point of view of the trained economist. We are therefore fortunate in having secured four articles from Dr. Frederick C. Mills, Assistant Professor of Business Organization, Columbia University, which will show the relationship between the principles which Dean Kimball has declared, and established economic laws which are recognized as exerting a major influence upon industry and business. Dr. Mills' series will begin in the February number, the first one dealing with "The Factors of Production," including natural resources, capital, population, organizing ability and the business unit. —*The Editors.*

The Office or Messenger Boy Problem

By WILLIAM LEAVITT STODDARD

Index Number
658.3112 Selecting the office boy

THE office or messenger boy is a necessity in practically all kinds of business. He is also a problem that is never permanently solved. From the point of view of the executive there is rarely such a thing as satisfactory messenger service: there are never messengers enough to meet the maximum demand; they do not always do what they should do; and they frequently do what they should not do. A considerable item of expense, erroneously called "non-productive," having a rapid turnover, they require constant attention and are apt to be no small source of daily friction and hence a loss of time.

Very little thought has been given to the messenger boy problem. Yet in several plants and office establishments where the subject has been carefully studied, the resulting experiments have amply proved worth while.

In the first place there is selection. In justice both to the employer and the prospective employee, to hire the right kind of boy is as important, relatively speaking, as to hire the right kind of machinist or clerk. The wrong kind of messenger boy can do a great deal of damage. The right kind can be a present joy and a source of future confidence.

What is needed to make a messenger boy? The qualifications are not extensive. Physical strength and mental alertness; the desire to make good; sufficient education and background or the ability to acquire education and background—these would seem to be the prime requisites.

The Specifications and Rules for Classification of Personal Service [1] has this to say about messengers:

Duties.

To receive and deliver moneys, valuable documents, papers and confidential messages for important state departments and officials.

To meet and direct visitors to various offices or officials.

To perform such incidental clerical work as may be assigned.

Qualifications.

(*a*) If appointed by promotion, not less than two years of appropriate experience in Grade II, Clerical Group; or

(*b*) If otherwise appointed than by promotion, at least two years of experience in work of Grade II, Clerical Group, character and standard; and in addition, such evidence of ability to represent the department as may be satisfactory to the appointing officer.

This is cited not because it applies generally to office or messenger boys in private service, but to illustrate the need and the value of having the job clearly defined together with an indication of the job's exit and entrance—where it comes from and whither it leads.

Selection having been made and duties assigned, the main part of the problem now arises—that of direction and of supervision over the work. Here again we commonly meet with an attitude of indifference on the part of the executive. Because the messenger job is at the foot of the ladder and he is, as an individual, a relatively insignificant member of the organization, there is a tendency to leave him to the devices of himself and his fellows. As a rule no one has charge of him, and if some one has, it is only a minor duty so performed.

Of course, nothing can possibly raise the office boy to the importance of a manager, but it is also true that nothing can raise him to the importance of being an effective office boy unless it is management. There are certain simple devices which tend to efficiency. One of these is that the boys should have a recognized chief, a man, preferably, who is young enough mentally to get along without too much discipline and yet with sufficient discipline to be distinctly felt. Another is that the duties of the boys should be clearly defined and performance strictly required. It consequently follows that the work should be planned for the boys.

The Boy's Combination of Head and Legs

A messenger boy is, ideally, a combination of legs and head. The importance of the former exceeds that of the latter in the early stage of his career. Gradually legs and head become of equal importance till finally, if at all, the messenger develops into a clerk or executive in whose work head chiefly counts. Head, then, is the ultimate aim, and hence it is that the employer is losing out—along with the employee—if he fails to educate his office boys "from the neck up," as the phrase goes. In rare cases there is no brain that can take training: the boy grows into a man with the same work or character of work stretching ahead for a lifetime.

This leads to another important consideration. While all care should be taken in the selection of messenger material, it is not always possible to secure boys who can rise. They may not be available, for one thing, or there may be no opportunity ahead, for another. Advancement is slow at best in most stable businesses, and advancement from the bottom is no exception to the rule. Thus it comes about that the turnover of messenger boys will be of necessity large. Its size, however, should not discourage the diligent manager, for he is dealing with human beings in the most formative and impressional stage of their commercial or industrial existence.

To recognize that the office boy presents a problem in administration is the first essential to the solution. To recognize, further, that he presents a problem that is peculiar and quite different from that of other classes of "help" is to approach the answer. Not alone in direct money outlay but also in time saved and work facilitated—equivalent, of course, to money—is the messenger boy question of sufficient importance to warrant serious study wherever such boys are employed.

[1] Adopted for the Commonwealth of Massachusetts under a law passed in 1918.

Establishing Standard Cost

"Increased Profits Through Control of Costs"—Article Five

By R. W. DARNELL

Controller, Ritter Dental Manufacturing Co.

Index Number

657.524:658 Cost control

THE proper method to be pursued in establishing a complete operating system for the factory is, as stated in an early article, to leave the installation of the cost system till the very last. And, as explained, the proper sequence of installing the various systems necessary to operate a factory is, first, production routing, then time-study and the wage-incentive plan, and after these, material specifications and the planning system. With these systems as outlined in previous articles properly installed and in operation, the foundation for the cost system has been established. Practically all there is left to do of a constructive nature to establish costs is to collect the information which is being used in the factory and build it into detail costs.

The cost system itself—important though it may be—is but one element in the control of costs. In preceding articles Mr. Darnell has outlined methods of planning, routing, payment of wages, handling overhead, etc., each of which plays its part in cost control. In the present article he describes in detail the system of standard costs showing its operation and its advantages over other cost systems in common use.

At this point the kind of a cost system to be operated must be determined. It should be remembered that in the beginning of these articles an example was taken of a plant manufacturing a standard product, and it was not contended that the plan as unfolded would necessarily apply in a job shop or in a plant manufacturing specialties.

There are three cost systems commonly used in plants such as taken for illustration, i. e., the Job Cost System, the Operation Cost System, and the Standard Cost System. It may be well to review briefly the features of the first two systems before taking up the third.

The Job Cost System

The Job Cost System is probably the best known of all cost systems inasmuch as it has been in use for a long time and is probably more generally used than any other system. This primarily consists of the issuing of job numbers to cover a specific lot of parts as they go through the shop from operation to operation, so as to have the material and labor charged directly to the job number. Some systems do not even attempt to charge their labor by operation, but content themselves with charging only to the job number itself and thus arriving at the total labor cost. Others in striving for a better analysis of the cost, charge their time against the specific operation upon which the workman is working, and post to the job order number the time and money spent on each operation as well as the number of pieces which are completed. At the completion of the job, the number of pieces finished is divided into the total material, labor, and overhead, and the cost of each is thus arrived at.

The Job Cost System is the ideal one for operation, but in "practice" it has been found that many discrepancies creep into the records and make them inaccurate. Those who are operating, or who have operated under the Job Cost System, can appreciate the fact that an order will perhaps be issued for, say, 5000 pieces, material drawn for 5000 pieces, and the work started through the plant. When the order is completed and the analysis is made of the cost, operation by operation, it is not infrequently found that 4975 pieces were finished on the first operation, 3859 on the second operation, 4475 on the third operation, 6250 on the fourth, and on the last operation there may be a total of 1857. Still in the face of all this, the stores department sends in a receipt for 5255 pieces. This seems incredible inasmuch as all the pieces had to go through the various operations and only 5000 were issued in the first place. This wide fluctuation in counts on the individual operations is due to the fact that more than one job on the same part is going through at the same time, and, the job numbers becoming confused, time is charged against the wrong job, finished parts are credited against the wrong job, and any number of other things go wrong.

After looking over a failure of this kind, the cost accountant makes up his mind that the cost found means nothing and disregards it, possibly taking some preceding job in which he has confidence. Inasmuch as the time has to be segregated according to job number and operation number, and posted against the job number in the cost department, the undertaking is a big one, and when this work is accomplished and then cannot be used, it is most discouraging.

In any plant that is operating under an up-to-date planning system, it will be found that from three to four job numbers will be issued on the same part during the year and that three or four costs are compiled during that period.

Under the Operation Cost System, the job number is disregarded and a permanent cost sheet is made up from the production routing. This cost sheet should show all operations necessary to complete the work

PART NO. P-1902 | ROUTING DATED 5-16-23

1. CHAIR | 2. A.C. ENGINE | 3. D.C. ENGINE | 4. A.C. LATHE | 5. D.C. LATHE | 6. A.C. COMPR. | 7. D.C. COMPR | 8. DIST PANEL | 9. ROTARY CONV | 10. A.C. UNIT / | 11. D.C. UNIT / | 12. SPR WARMER | 13. A.C. X-RAY | 14. 220 VOLT D.C. X-RAY

RITTER DENTAL MANUFACTURING CO., INC.

COMPARATIVE OPERATION COST SHEET

Back Cover for Pedestal on Unit Equipment

USED ON

OPERATION NUMBER	OPERATION NAME	DEPT PERFORMED IN	DATE OPERATION ADDED OR OBSOLETED	TIME ALLOWED PER PIECE	PERIOD Nov. 1922 LABOR RATE PER HOUR	LABOR COST PER PIECE	OVERHEAD RATE PER HOUR	OVERHEAD COST PER PIECE	PERIOD Nov. 1923 LABOR RATE PER HOUR	LABOR COST PER PIECE	OVERHEAD RATE PER HOUR	OVERHEAD COST PER PIECE	PERIOD LABOR RATE PER HOUR	LABOR COST PER PIECE	OVERHEAD RATE PER HOUR	OVERHEAD COST PER PIECE
3	Sand Blast	12		Indirect		✓		✓		✓		✓				
				Labor												
7	Snag grind 4 lugs	12		1.35	$.60	$.0135	$1.30	$.0292	$.63	$.0142	$1.20	$.0270				
10	Mill flat on face	7		4.20	.58	.0406	1.60	.1119	.61	.0427	1.45	.1015				
15	Drill 4-5/16" holes through cover	9		3.00	.55	.0275	1.45	.0725	.59	.0295	1.30	.0650				
16	Co-bore to 37/64" thickness. Co-bore .450" dia 3/16" deep for 5/16" fillister head screw.	9		2.30	.55	.0211	1.45	.0557	.59	.0226	1.30	.0498				
17	Drill (2) #52 holes for name plate	9		.73	.55	.0067	1.45	.0176	.59	.0072	1.30	.0158				
20	Straddle mill ends to 14.621" over all lengths plus or minus .002"	7		5.40	.58	.0522	1.60	.1440	.61	.0549	1.45	.1305				
23	Grind radius of inside edge of top and bottom of cover.	12		.40	.60	.0040	1.30	.0087	.63	.0042	1.20	.0080				
	Inspection	21		Indirect		✓		✓		✓		✓				
				Labor												
					TOTAL	.1656		.4396	TOTAL	.1753		.3976	TOTAL			

MATERIAL SPECIFICATIONS

R. NO. | QUANTITY EACH

DESCRIPTION *Aluminum Casting*

	PERIOD Nov. 1922	PERIOD Nov. 1923	PERIOD
MATERIAL COST PER UNIT			
MATERIAL COST EACH	$.3406	$.3623	
LABOR COST EACH	.1656	.1753	
OVERHEAD COST EACH	.4396	.3976	
TOTAL COST EACH	$.4017	$.4963	
COSTED BY	J. L.	J. L.	

FIG. 18 AN OPERATION COST SHEET

and should apply its information by operation only. This is a step forward from the Job Cost Method inasmuch as it does away with many of the inaccuracies of that method. In fact, as the operators are working under a premium plan, whereby the pay is determined on a time-allowed basis, and it is necessary for the time ticket to be accurate in order to pay off, there should be no question as to the correctness of the costs.

In order to get accurate costs for stores records, under the Operation Cost Method, it is necessary to cost out all operations, at least every two months. This is done by accumulating all productive labor time tickets over a period of two months and sorting them first according to part number, and next, to operation number. Then all time, money, and pieces are totaled on each operation and posted to the cost book. The labor cost is figured by dividing the money earned by the pieces finished, and an overhead cost on the operation is found by extending the hours worked, by the overhead rate, and dividing that total by the number of pieces finished. All operations may not be completed within the costing period; some might have been started in the previous period, and others will not be finished until the following period. This leaves an incomplete cost in the period under consideration, and in order to arrive at a total cost, there must be more or less estimating of figures. The operation costs completed in the preceding period must be carried forward, as must also the operation cost of the unfinished operation from the last batch of material finished. The total of these operations would then give the labor and overhead cost, but it cannot be said to be accurate as to what is actually occurring within the plant on these operations.

Determining Material Costs

Under the Job Cost System, it was stated that all material requisitions drawn from stores and given a job number, were charged into that job cost at whatever prices the raw material stores records showed for it. This means the handling and posting of a great many stores requisitions, and, inasmuch as there may have been additional requisitions drawn beyond the original requirements, or perhaps material is returned to stores on credit, there is apt to be more or less confusion in arriving at a material cost. It has been found to be much more simple, and very much more accurate, to base material costs on material specifications. A preceding article[1] described the method by

[1] See MANAGEMENT AND ADMINISTRATION for November 1923, p. 605.

which these material specifications should be drawn up and the manner in which the quantities of raw material required on each part were computed. Under the Operation Cost System, the object in mind is to arrive at the cost of each, and inasmuch as it has been determined how labor and overhead costs are compiled, the next thing to consider is the determining of the material cost. On the Operation Cost sheet should be allowed a space for material specifications, showing the kind and size of material used together with the quantity used per piece. From the rough stores inventory records, is taken the cost per pound, or per foot, or per whatever unit of measure is required to price out the material, and this is extended by the quantity required each, and gives the material cost. This, then, together with the labor and overhead, gives a complete cost of the part.

Standard Cost

The method of costing of the Operation Cost System is, as said before, much better than that of the Job Cost System. However, while the Operation Cost System might be desirable from the standpoint of accuracy, it is not desirable from the standpoint of simplicity. It requires a great deal of clerical labor to keep up, and at the same time a great many costs are being compiled on each part during the year which would seem to be unnecessary.

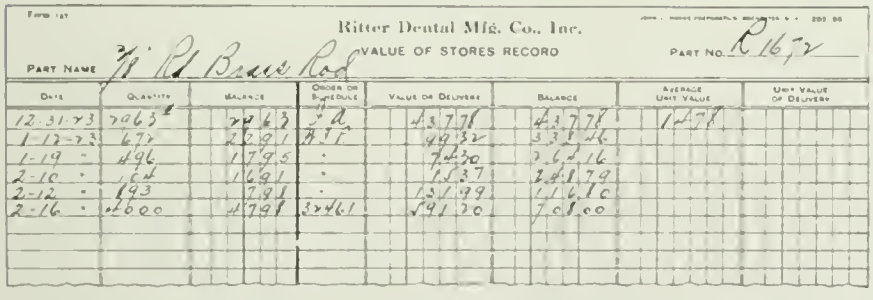
A new method of cost accounting, with merits of its own, is coming into vogue. This is known as Standard Cost and is somewhat similar to the Operation Cost System inasmuch as the standards are set on each operation and then built into complete costs. As mentioned before, the plant used to illustrate the present series of articles is operating under the 100 per cent Premium System. One of the advantages of this plan is that labor costs do not vary after standard is reached; or, in other words, as soon as an operator begins to make premium, the labor cost does not vary, regardless of whether he makes 1 or 100 per cent over the day rate. This is due to the fact that he receives all the savings which he makes under the time allowed. The only way that a labor cost can vary, is when an operator fails to make premium, and then the cost will increase in proportion to the amount of time lost.

If a premium plan of this kind is operated successfully, from 95 to 98 per cent of all operators working on premium should equal standard or better. This means that from 95 to 98 per cent of the labor costs are constant—therefore it is not necessary to have a large clerical force figuring costs month after month. The one thing to watch under a method of this kind, is the operator who fails to make premium, inasmuch as he is the only one who can cause a labor loss.

An Operation Cost sheet as shown in Fig. 18 is made up for each part manufactured. The original sheet before costing, is filled in with the operation number, the operation name, the department performed in, the date operation is added or obsoleted and the time allowed. All this information is taken from the Production Routing sheet and is necessary for the operation of the factory system. By having the department number in which the work is to be performed, and the amount of time allowed to do the work, it can be seen that the day rate of the class of operator who does this work is the only information necessary in order to arrive at a standard labor cost per operation. If the first two operations are performed in the hand-screw machine department, and hand-screw machine operators are being paid a day rate of 60 cents per hr., this information is listed under labor rate per hr., and so on with the other departments through which the work passes. Under the first operation, the time allowed is 1.35 min. which at 60 cents per hr. gives a labor cost per piece of $0.0135. Other operations are figured in like manner, and when totaled show a standard labor cost of $0.1656.

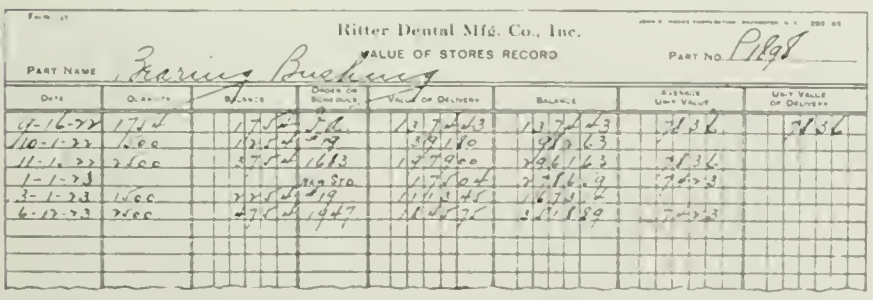
The next thing to consider is the overhead cost, and where this is determined by a departmental hourly overhead, the overhead rate for each department on the cost sheet is listed. Under the first operation which is performed in department 12, the overhead rate is $1.30 per hr. The $1.30 extended by the 1.35 min. time allowed, gives an overhead cost per piece of $0.0292. After computing the other operation overhead costs and adding, the total overhead cost is $0.4396. Under the material specifications, it is noted that the material specifications is for an aluminum casting, and that the material cost each in 1922 was $3.4065.

In order to make the cost absolutely standard, it is necessary to standardize the material costs, and this is accomplished by setting up an arbi-


Ritter Dental Mfg. Co., Inc.
VALUE OF STORES RECORD
PART NAME 3/8 Rd Brass Rod
PART NO. R 167

DATE	QUANTITY	BALANCE	ORDER OR REQUISITION	VALUE OF DELIVERY	BALANCE	AVERAGE UNIT VALUE	UNIT VALUE OF DELIVERY
12-31-23	2963	2963	Inv.	43 77	43 77	1477	
1-12-23	477	2486	R 17	99 32	343 46		
1-19 "	496	1990	"	7 30	336 16		
2-10 "	164	1826	"	15 37	320 79		
2-12 "	193	1633	"	15 99	304 80		
2-16 "	1000	4633	3x461	591 20	896 00		

FIG. 19 PERPETUAL INVENTORY RECORD SHOWING STANDARD MATERIAL COSTS


Ritter Dental Mfg. Co., Inc.
VALUE OF STORES RECORD
PART NAME Bearing Bushing
PART NO. P 198

DATE	QUANTITY	BALANCE	ORDER OR REQUISITION	VALUE OF DELIVERY	BALANCE	AVERAGE UNIT VALUE	UNIT VALUE OF DELIVERY
9-16-22	1714	1714	Inv.	10 74 43	10 74 43	3482	3482
10-1-22	500	2214	R 19	39 80	90 63		
11-1-22	2000	4214	1613	139 00	496 163	3436	
1-1-23		4214	Inv. Stock	1 74 04	2 70 69	3423	
3-1-23	1500	5714	R 19	111 45	1 82 14		
6-12-23	2000	7714	1947	141 89	3 24 03	4203	

FIG. 20 PERPETUAL INVENTORY RECORD SHOWING STANDARD MATERIAL COSTS PER PIECE

trary standard at the time the standard costs are being compiled. This standard, while spoken of as arbitrary, is really based on current market conditions together with future anticipations of the market, and for a plant that is using sheet steel, sheet brass, sheet copper, bar steel, bar brass, bar copper, castings, etc., there is not likely to be any great fluctuations. These standards are set up on perpetual inventory records in the manner illustrated in Fig. 19. This standard cost is left on the inventory record until such time as it is deemed necessary to refigure the standard. There are bound to be fluctuations from the standard set up on the inventory record when buying new supplies of stock, but these fluctuations are taken care of in a Material Variation account set up in the factory ledger.

This Material Variation account works out in the following manner. If, for instance, ½ in. round steel is being carried on the inventory records at $0.06 per lb. standard, and it is found when purchasing a new batch of material that the invoice price is $0.06½ per lb., there is a variation from standard of ½ cent per lb. If the invoice calls for 1000 lb., this must be entered on the inventory records at 6 cents, which is standard, and the material therefore put into the inventory at $60 whereas the price paid is $65. There is thus a material fluctuation set up of $5. These variations are accumulated at the end of the month and if the net result of the fluctuations shows that material has been purchased for less money than the standard, the book inventory as carried in the factory ledger is debited, and the material variation account credited. This credit is subsequently carried to cost of sales for the current month and acts as a reduction of cost of sales, which in turn reflects an increased profit. However, these variations from standard will be discussed more in detail in a later article. The present discussion suffices to establish the fact that material is carried at the standard price and is carried into the costs at that standard.

Total Standard Costs

With the material costs standardized, they are then carried to the individual cost sheet and the material requirements of each part extended by the standard material costs, to arrive at the standard material cost per piece. This, then, together with the standard labor and the standard overhead which has been arrived at, determines the standard cost per piece. Perpetual inventory records are shown in Fig. 20 and are also carried on finished piece parts in stores and the inventory itself is set up on the basis of the standard cost arrived at. For instance, as shown in Fig. 18, the cost of part 1902 is found to be $4.0117 each—$4.1963 each for November 1923—and if there are 1000 parts in stores, the inventory value is established at $4,011.70.

After having established the standard cost on all parts, it is then necessary to build up the standard cost on subassemblies and final assemblies. In order to do this, it is necessary to divide the assemblies into several sections. This is necessary owing to the fact that several subassemblies are built up and carried in stores and then withdrawn and incorporated in still other subassemblies, and those assemblies stored, and so on through until the larger subassemblies are withdrawn from stores to be built into the final assembly. It can be seen that by promiscuously building up standard costs on assemblies, a great deal of difficulty would be encountered in pricing out the parts and subassemblies contained in the subassemblies being costed. This can possibly be illustrated by considering the pricing out of a major subassembly among the first assemblies. It would be impossible to cost this completely, due to the fact that some of the minor subassemblies that go into the major subassembly had not been costed, so that the first group of subassemblies to be costed would be those which contain only piece parts because these can be costed out without any difficulty inasmuch as all piece parts have been costed.

ASSEMBLY NO. 600-G-1
ROUTING DATED 8-22-23

RITTER DENTAL MANUFACTURING CO., INC.
ASSEMBLY
MATERIAL SPECIFICATION SHEET

PART NUMBER	PART NAME	QUANTITY USED	PERIOD Nov. 1922 Cost each	PERIOD Nov. 1922 Total Cost	PERIOD Nov. 1923 Cost each	PERIOD Nov. 1923 Total Cost	PERIOD Cost each	PERIOD Total Cost
P-393	Washer, micarta	10	$.0006	$.0060	$.0006	$.0060		
P-441	Screw	4	.0025	.0100	.0028	.0112		
P-1003	Washer, brass	2	.0015	.0030	.0017	.0034		
P-1395	Washer, brass	4	.0017	.0068	.0018	.0072		
P-1500	Nut, steel	2	.0075	.0150	.0083	.0166		
P-1759	Washer, cup	2	.0023	.0046	.0024	.0048		
P-1824	Washer, micarta	8	.0004	.0032	.0004	.0032		
P-2014	Screw	3	.0031	.0093	.0033	.0099		
P-2401	Washer, steel lock	3	.0022	.0066	.0024	.0072		
P-3421	Screw, dowel	2	.0041	.0082	.0044	.0088		
P-3422	Screw, cap	2	.0113	.0226	.0115	.0230		
P-3424	Screw, set	2	.0093	.0186	.0099	.0198		
P-3429	Brush, carbon	2	.0926	.1852	.0978	.1956		
275-G-4	Nut, cap moulded	2	.0873	.1746	.0896	.1792		
599-G-1	Armature, wired	1	6.9132	6.9132	7.0314	7.0314		
601-G-1	Coil, field	2	2.1571	4.3142	2.1987	4.3974		
603-G-1	Holder, brush	2	.1462	.2924	.1503	.3006		
604-G-1	Fan, blade 8" dia	1	1.1632	1.1632	1.1721	1.1721		
605-G-1	Guard, fan	1	.6154	.6154	.6342	.6342		
621-G-1	Housing, for motor	1	1.3716	1.3716	1.4016	1.4016		
647-G-1	Field, laminated	1	2.8617	2.8617	2.9115	2.9115		
TOTAL				$18.0034		$18.3445		

FIG. 21 MATERIAL SPECIFICATION SHEET

The next group would be those subassemblies which take in the first group and those few piece parts necessary to complete the second group. The various groups will be so segregated that when costing, there would always be a new price on the minor subassemblies going into the assembly under consideration.

In building up a standard cost on subassemblies, it is necessary to make up a material specification sheet (Fig. 21) for each assembly to be costed. From the material specifications made up by the engineering department and described in a preceding article [2] those parts which are contained in the various subassemblies,

[2] See MANAGEMENT AND ADMINISTRATION for November 1923, p. 605.

are listed under the material specification sheet. This information will comprise the part number, the part name, and the quantity used in each assembly. From the cost built up on these parts is taken the standard price for each part indicated on the Material Specification sheet and as if, under the illustration, P-393 has a cost of $0.0006 and there are 10 parts used in the assembly, the material cost as indicated, is $0.0060. All

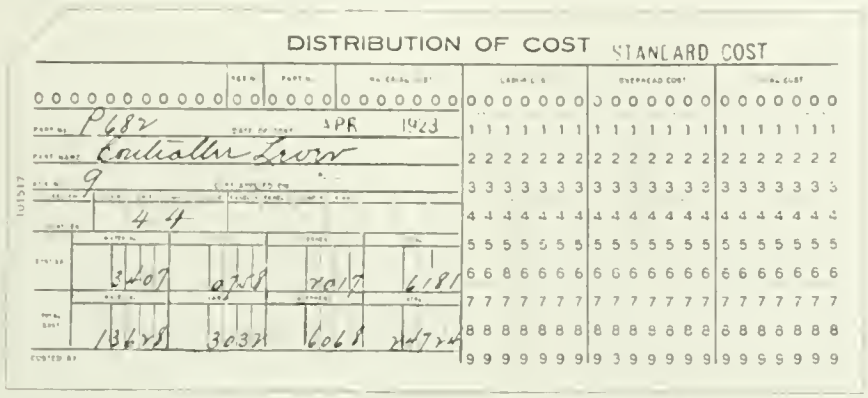


FIG. 22 CARD SHOWING THE DISTRIBUTION OF COST

other parts in the assembly are priced out accordingly, and when finished are totaled to give the total cost of the various parts going to make up the assembly.

The labor and overhead necessary to assemble each of these assemblies are computed on the form shown in Fig. 18. The operations are taken from the routing book, as is also the operation name, the department performed in, date operation added or obsoleted, and the time allowed per piece. The same procedure is followed in costing out the labor and overhead as is the case with piece parts, but the material cost each as indicated in the lower section of the form, is the cost of the parts going into the assembly, and is taken from the total cost as shown in Fig. 21. As each group of assemblies are costed, that cost is also carried to the perpetual inventory records and whatever stock there is on hand is included in the inventory at the standard cost of the assembly.

Analyzed Costs

The general manager or factory manager quite often, when looking over completed cost figures, would like to know how much actual material, labor, and overhead is included in the cost of the completed article. Under the ordinary run of cost systems, in fact, under almost any cost system, it is rather difficult to compile the costs in such a way that these figures are readily available. It is easy enough to compile the total costs including material, labor, and overhead, but the total of each element in the final cost is quite another matter.

Working under a standard cost system, as has been outlined, this information can be built up very readily at the time the individual costs are being compiled. Material, labor, and overhead are computed separately, and by the use of a tabulated card, such as is shown in Fig. 22, can be brought together on this card, which shows the part number and the name of the part, as well as the date on which the cost is compiled. In the body of the card following the heading, "Used on," are listed the various pieces of equipment which are manufactured; and directly under this is the quantity of this particular part used on each piece of equipment. These articles of equipment are given key numbers, and the key number applying on this particular card is also shown. In the illustration, it shows that P-682, which is a controller lever, is used on the unit and engine in quantities of four each. In this case, it would be necessary to make out two cards, one for the unit and one for the engine, because it is required that a detailed cost be obtained on each article of equipment. Assuming that a card was made up for the unit, which is key 9, the cost is taken from the detailed cost sheet of Fig. 18 for the controller lever. This would show the following cost for each: material $0.3407, labor $0.0758, overhead $0.2017 and the total cost of $0.6181. Inasmuch as there are four parts used on the unit, it is necessary to extend all this by 4 to get the complete cost of this part contained in the unit. This now shows that the total cost of these parts has material costing $1.3628, labor $0.3032, overhead $0.6068 and total of $2.4724. A card for the engine is made out in like manner, and similar cards for each part which is manufactured.

The procedure in costing out subassemblies is somewhat different, inasmuch as no material cost is shown, except in instances where actual raw material is used in the assembly process. As an illustration of this, it might be shown that the winding of an armature, while made up of a number of piece parts, also used a quantity of magnet wire which in itself is considered as rough stores. This item of rough stores, then, is the only material cost which is given at this stage, inasmuch as all material going into the final assembly is indicated in the piece parts. The labor and overhead on the assemblies, however, is shown the same as it is under the piece parts, and a card is made out for each subassembly in the final assembly.

If these cards are run through the key punch machine, and the information contained on them is punched, and the cards are then sorted by key numbers, the cards for each piece of equipment will be segregated. Running the cards for each piece of equipment through the tabulating machine will give the total material, labor, overhead, and total for each piece of equipment. The total cost must check out with the total cost as shown on the cost sheets, and if these figures agree, the total for the various elements of cost is obtained. The procedure as outlined is all the actual cost work that is necessary during the year or during the period of the standard cost. Thus a great deal of time and effort is saved over other methods in trying to compile actual costs.

As contended in the beginning some cost systems require the service of a large clerical force, compiling costs day after day and month after month, when 95 per cent of these costs do not vary. The costs as they would be made up under those conditions are of no benefit, as nothing can be done to reduce them because

the articles are already produced at the lowest cost possible. It seems to be much more practical, and very much more economical, to devote the time of those in the cost department to these jobs that are not up to standard, and therefore, produced at an increased cost. The other 95 per cent of the work takes care of itself, and if the entire time of the department is spent in an effort to control the costs which are not up to standard, much can usually be done toward reducing costs, which is really the primary reason for a cost department.

The standard costs as used are probably more accurate than costs determined by any other system.

In operating a Standard Cost System once properly established, the variation from standard should not be in excess of 3 per cent, which indicates that the costs being used are 97 per cent correct. The author has yet to see a cost system operated under the so-called "Actual Cost Method," that is as close as 3 per cent.

The Qualified Nurse in Industry

By WINIFRED HARDIMAN

With the Terry Steam Turbine Company

TO the average manufacturer a woman who dons a white uniform is a nurse, but the name is often a misnomer. The white uniform today is not significant unless worn by a woman who has earned the right to do so by at least two years of hard work and study, in hospitals qualified to equip her with the necessary knowledge and skill to cope with industrial problems.

Neither should we assume that because a nurse is an excellent institutional or private duty nurse, that she is the right type for industry. The latter calls for a special type of woman. Particularly is this true in the small plant where there is no physician in charge. In such a plant she will require excellent judgment, ripened by experience.

Questions for the Nurse to Answer

There are certain concrete questions to ask the nurse applicant for a job. If her answers to some of them are negative, set your danger signal. She will not be a success, but a dismal failure in the plant. Enumerated below are a few leading questions:

1. Do you understand "The Medical Practice" in this state?
2. Do you understand the meaning of first aid?
3. Do you believe in accident prevention?
4. What is compensation?
5. Do you understand the meaning of occupational diseases?
6. From which hospital did you graduate?
7. Are you state registered?
8. In what branches of the profession have you had training?
9. Are you democratic?
10. Are you loyal to your employer?

Many manufacturers make the mistake of engaging a young, pretty nurse, without realizing that although she may be restful to the retina, she may be bad for business.

A woman of mature years with wide experience is by far the better type. She is more apt to be interested in her job, and less likely to use it for a lunch wagon on the road to matrimony. Then, too, she has been broadened by contact with the world, and is more sympathetic and democratic.

Index Number

658.383 Nurses in Industry

Such a nurse has much to give industry. She can play the triple rôle of teacher, adviser, and friend. She can keep the individual well and happy if he has confidence in her and her work. She can be of inestimable value by giving good advice when the wife or kiddies are ill, or when financial difficulties occur.

Assistance in Plant Operation

Home worry is one of the great handicaps to the individual worker; another is a wrong mental attitude regarding his work or foreman. Cure his grouch and you double his worth to industry, besides making him a happy man and a producer.

Statistics prove that indoor workers break down more rapidly than outdoor workers. The nurse can supervise general health, suggest desirable living conditions and proper food.

The nurse can form safety committees made up of foremen, and explain to them what she is trying to do for industry. She can prevent epidemics from spreading through the plant by early treatment, and make suggestions regarding heat, light, ventilation, and sanitary conditions. Here she is an important factor, as occupational diseases are concerned with compensation.

Interpretation of Compensation Acts

Under compensation acts the nurse owes equal obligations to claimant, insurer, and employer, and she should have a definite understanding of the law and its provisions.

Having found the right type, trust her, believe in her work, do not ask her to work for you, but with you. There is a big difference in being at the banquet and looking on.

A nurse in industry has a trying job, particularly if she feels the management is not interested in her work. Make her a departmental head, responsible to you, and not a subordinate, for you have wonderful opportunity for teamwork. Give her your hearty cooperation and through her your employees will have the health which helps to make them efficient and contented workers.

The Compilation of a Budget

"Control Through Organization and Budgets"—Article Two

By THOMAS B. FORDHAM and EDWARD H. TINGLEY

Superintendent, Delco-Light Co. *Engineer, Delco Light Co.*

THE preceding article[1] has described in detail the organization of a business into its four divisions —engineering, sales, finance, and manufacturing — each with their sections and departments. With such subdivisions it is very easy to obtain accurate estimates of operating expenses for the period of the budget.

A budget requires three important activities: (1) Careful planning for the future; (2) careful execution of these plans; (3) careful checking of the results. It is usually the general manager that plans, the division heads who execute the plans, and the comptroller who checks the results. It is not enough that estimates are made for future expenditures, and quotas set for the sales division to equal, but these expenses must not be exceeded, and the sales force must make a determined effort to sell even more than its quotas. It is only through a concerted and purposeful effort by all divisions of a business that the budget can be met.

As a budget is a forecast of future conditions, the period to be covered may be a variable quantity. Some industries plan five years ahead, others only one. No matter what the length of the longer period may be, there should be a short period over which intensive estimates are made so that the many variables in business may be taken care of. With ever-changing market conditions for raw materials, fluctuating sales demand, new inventions placed in production, and wide-awake competitors, one to two months is about as far ahead as can be intelligently planned for in minute detail. Where production processes permit, one month makes a very satisfactory period for a detailed budget, to which can be added a forecast for two or three months ahead.

To describe better the method of using a budget and the results to be obtained, the following list of steps in controlling a business through a budget is given.

1. The general manager determines the percentage of profit desired, and which reasonably can be expected, upon the capital invested in the business.
2. The comptroller analyzes the costs of the product, the market, and the past expenses of doing business; sets a quota of units of the product which must be sold; allots the amounts of money which can be spent by the various divisions; the results of which will be the profit desired.
3. The comptroller gives to each division head the estimates he has devised covering the activities of that division. The division head breaks these down into departmental needs and expenses when operating under the estimated schedule. Each department's expenses are carefully estimated; and the total for the entire division should equal the allotment given by the comptroller.

Index Number
658.16 Organization
658.14 Financial control

4. If the division head believes that he cannot do his full duty and operate within the amount allowed for expenses in the estimates of the comptroller, he takes the question up with the comptroller and arranges an adjustment.
5. When all divisional budgets have been adjusted and summarized the final figures are given to the general manager, who approves them if satisfactory and authorizes each division to proceed accordingly.
6. Each division co-operates in its plans with the others, and schedules of production are made to coincide with the estimated sales demand.
7. Items of expense are closely watched and efforts made so to operate each division that the actual expense is kept within the allotted amounts.
8. The comptroller compiles a periodical Profit and Loss statement (monthly or quarterly) in which he sets forth the receipts from the sale of the product, the expenditures made by the various divisions of the business, and the resultant profit, if any. This is in a comparative form placed item for item alongside the estimated budget figures.
9. This report is sent to the general manager who reviews it and asks an explanation where certain items of expense exceed the allotted amount.

The general manager or president at a certain period of the year looks forward to the coming year and plans for this future period. He is familiar with general business conditions and has been studying statistics of the past years of the company. He may come to the conclusion that 1924 will be 10 per cent better in sales possibilities for his product than was the year 1923. (It is assumed that the company has been in operation for several years.) He estimates that the company ought to be able to earn 25 per cent profit on the invested capital. Having decided that this is a profit that may reasonably be expected, he calls in the comptroller and presents the problem to him for a suggested solution.

Every business, whatever its size, should have some person in the organization who knows enough about the internal operation of the business to be able to compile the necessary data of income and expenses

[1] See MANAGEMENT AND ADMINISTRATION, December 1923, p. 719.

which can be made into a budget. He must also analyze reports and facts that he secures from various sources, to give the general manager a perspective of the status of the business at any time. In the larger-size companies such a man is called the comptroller, and this meaning of the word will be used throughout these articles.

The modern comptroller must do more than just check the financial results of a business, for his complete responsibility includes the analysis of the expenses of all divisions to determine if the money spent has been most effectively used. To this end, he must maintain statistics and records in his office that will be his aids and guides in passing judgment on the advisability of all expenditures, and will enable him to know whether plans proposed are sound and possible of execution. He must serve the chief executive in an advisory capacity, furnishing him with data and estimates on any subject that directly concerns the business operation of the company. In general he must have information regarding the following:

1. Engineering Division. The list of products made and their capabilities. Special adaptations or modifications. New products being designed. Expenses of the engineering work.
2. Finance Division. Details of the financial condition of the business. Cash on hand. Credit rating. Accounts payable. Accounts receivable. Estimates of future income.
3. Manufacturing Division. Maximum capacity of the equipment in the factory to manufacture various schedules of the products. Present used capacity. Detail of manufacturing expenses on a normal operating basis and each month's actual expenses. Material purchases. Labor pay-rolls. Estimated and actual manufacturing costs of the various products.
4. Sales Division. Detail of the sales territories as to past sales records, percentage of profits made, possible number of prospects, population, best advertising mediums, number of salesmen, selling expense, advertising expense, estimates of future sales, etc. Sales of each product, profits made on each product, sales possibilities and new products being designed.
5. Statistics of general business conditions and future trends.

The general manager, in discussing the problems of next year's business with the comptroller, states the aims which he wishes accomplished. While he may propose conditions which seem impossible, nevertheless it remains for the comptroller to study the records, make the estimates, and tabulate the weak points in the plans. Figuring on the basis of 25 per cent profit, the net profit which must be earned is easily calculated. To the net profit must be added all the expenses of operating the business to find the gross income necessary. Assuming that income is entirely from the sales of the product, an estimated schedule of sales can then be made.

From the first tentative drafts of the sales schedule detailed analyses can be made of the operating expenses of each division when producing and marketing to such a schedule, and a budget of expenses can be drawn up. The data on the manufacturing division must be studied to determine whether the equipment and floor space are sufficient to produce the required quantities of the various products. If they are not, what amount of new equipment will be necessary, and how much will this increase the assets of the company? Studies must be made of the effect of increased production on the cost of the products, on the reduction of the burden rate as applied in the cost of sales, and on the equipment.

The increased demand for materials due to the larger schedule may mean increased storage space for both raw and finished parts, involving expenditure. Increased sales schedules will require larger inventories to be maintained, therefore, increased taxes will follow, but with possibly decreased material costs due to the ability to purchase larger quantities at a time. More working capital must be provided to finance the increased expenditures for labor and materials.

Basis of the Sales Quota

For the tentative schedule of sales, the expense of advertising the products must be estimated. From the analyses of advertising mediums and the prospects of the various territories the amounts of money to be allotted to advertising for each district can be tabulated. Also, the quota of sales can be made by products for each sales district. This quota will be based on a study of the population—whether rural or urban—wealth, occupation, and other statistics. The number of new salesmen necessary to sell the increased schedule is listed and the added selling expense estimated.

The comptroller, having considered all the contributing factors and limiting conditions, finally arrives at a sales and production schedule that must be followed to bring in the gross income, and a budget of divisional expenses which must not be exceeded if the net profit of 25 per cent is to be earned. He makes a full statement to the general manager, pointing out all the limiting conditions, the weak places, and the possibilities for profit if certain intermediate steps can be accomplished. The program and budget is carefully reviewed and studied by the general manager who finally determines what schedule will be adopted and how the budget of expenses will be divided.

The heads of the four divisions of the business are then called in conference with the general manager and the comptroller and the new schedule and budget is submitted to each of them for study and comment. Each division head studies the schedules and amounts allotted for expense and makes a careful survey of all the departments under his direction. The section heads and department heads make up their estimates of expenses when operating under the proposed schedule. These estimates are summarized and carefully checked by the supervisor of each section. They are then forwarded to the division head, who compiles them into a budget for the entire division. The total of this budget must be the total of the expense allotted by the comptroller. If the totals do not agree, the division head

must arrange the departmental estimates so that he can keep within the allotted totals, if possible.

When the plans for the coming year have been tentatively decided upon and each division has been given the estimates of sales, production, and expense quotas, it then rests with the division heads to plan their work in detail so as to be ready to begin the new year on a basis that will produce the desired results. The department heads are given a statement of the requirements with which they are concerned, and, in turn, estimate their expenses and purchases and the number of employees necessary to carry out the program. The method of gathering these estimates and co-ordinating them into a budget will be described in detail in the following paragraphs.

The One-Month Basis for a Budget

It can readily be understood that although the year's budget has been based on the expectations for the entire year's business, each month must have a separate and distinct budget which will carry the most accurate forecast possible, based on the seasonal variations in sales demand, production methods, and general business conditions. From the four months' schedule, as given by the general manager, the manufacturing division can make general plans, order material, and schedule deliveries so that the warehouse maximums and minimums as set by him will not be exceeded. But it is from the one month's schedule that the budget figures are gathered and the forecasts of the two months following are made up. Each month's production schedule is made up as follows:

About the fifth of each month, the superintendent of the manufacturing division, the sales manager, or his representative, and a representative of the finance division, usually the comptroller, hold a conference and predetermine the manufacturing schedule for the following month. This production schedule is based on sales expectation, quantity in warehouses, orders on hand, and such other information as may be obtainable as a guide. This schedule is submitted to the manufacturing division before the fifteenth of the month, in order that as much time as possible may be given for the necessary preparation.

After the schedule is given to the manufacturing division and the departments have begun estimating the amount of material and pay-roll necessary for its performance, it should not under any circumstances be changed for that month. Very careful thought must always be given to the making up of this schedule to avoid any changes.

The budget of the materials section must include the total cost of new productive materials to be purchased for the budget period. The total of new material purchases will include whatever amounts are to be ordered released during the four months' period on contracts already made. These amounts represent cash requirements at some future date and the treasurer must know this so that he can be ready to pay the invoices and take advantage of the discounts.

As a prerequisite to making up the lists of materials to be purchased or released, the storerooms for raw and finished stock, and the entire materials section, must be well organized. A stock record department should be established and records kept of all raw stock, purchased finished parts, and finished manufactured parts and subassemblies.

With balances of stock on hand shown by the cards in the stock record department, it is but a matter of a few days to check over all the records and order enough piece parts and assemblies so that the schedule assigned for the next month will be fully covered. This list of parts needed is made under two headings: (1) Parts to be purchased from outside sources of supply; and (2) parts and subassemblies to be manufactured within the factory. The purchase request department estimates the cost of the purchased parts and the cost of the castings, bar steel, etc., to be ordered. This total is sent to the superintendent's office as the budget estimate of productive materials. (See Table 1. The stock record department keeps a list of non-productive materials, and a cost statement of stock to be ordered

TABLE 1. ESTIMATE OF PURCHASE EXPENDITURES (PARTIAL)
Manufacturing Division. Month of October, 1923

SYMBOL	DESCRIPTION	QUANTITY	APPROX. COST
Fm. 71	Battery charge tag	2000	$ 9
Pc. 251	Ignition coil assembly	1000	2,880
Pc. 1254	Ball bearing	2000	6,880
Pc. 1326	Contact arm assembly	3000	870
Pc. 2746	Cylinder head valve	5000	1,900
Pc. 2764	Piston ring	5000	375
Pc. 2781	Breather plug	4000	120
Pc. 9167	Muffler head	2500	515
Pc. 9168	Muffler head	2500	490
Pc. 9303	Breather valve cap	1500	75
Pc. 9311	Breather tube cap	2500	300
Pc. 9395	Cylinders	150	692
Pc. 9469	Carbon brush	2000	15
Pc. 9510	Cap	1000	200
Pc. 9569	Piston ring	2000	180
Pc. 9577	Felt washer	5000	5
Pc. 9741	Fuel pump valve ball	1000	8
Pc. 9832	High tension clip	5000	60
Pc. 9873	High tension lead rivet	1000	12
Pc. 9875	Cover plate spring	1000	15
Pc. 9878	Fuel pump check valve ball	2500	5.50
Pc. 9879	Lock-washer	2000	3
Pc. 9883	Fuel pump fulcrum spring	1000	8
Pc. 9884	Piston	500	200
Pc. 9888	Piston ring	3000	240
Pc. 9891	Cylinder head	250	900
Pc. 9897	Piston	250	500
Pc. 9898	Crankshaft	1500	2,700

is sent to the superintendent's office for budget purposes.

To facilitate the work of the purchase request and the purchasing departments, partial lists of materials needed are sent from the stock record department as fast as prepared. This allows the maximum of time to make out the purchase requests which are forwarded at once to the purchasing department so that they may secure bids and place orders for the materials. The list of amounts of materials to be released on existing contracts is also sent promptly to the purchasing department so that early deliveries can be secured.

In the meantime, the shop order department has compiled the list of parts to be manufactured and sends several copies to the supervisor of the productive section. The necessary shop orders, raw stock requisitions, and assembly requisitions are written up and held in readiness for release in time to get the parts in finished stock to meet the final assembly schedule.

The supervisor of the materials section must also submit a list showing the proposed increase or decrease

in number of employees throughout all the departments under his control. This will, of course, vary somewhat with the production scheduled for the next budget period. An increased schedule will mean more men to handle the receipt of raw stock and the trucking of it to its storage space; more men to make up and give out finished stock for assembly and more men to pack and ship the finished product. A decreased schedule would mean just the reverse.

Planning the Production Budget

Upon receipt of the lists of parts to be manufactured, the supervisor of the productive section gives to each foreman a list of parts and operations to be done in his department during the next budget period. From this list the foreman makes up an estimate of the number of men required and the main items of non-productive materials necessary. The supervisor makes up a statement of the increase or decrease in the number of employees he will need for the next month, and the totals of non-productive materials or supplies required. This is given in detail for each department, specifying the number of men and the kind of work they will do.

The list of productive section labor is retained in the superintendent's office and all requests for new employees are carefully checked against it so that the numbers specified are not exceeded. The control of labor is maintained by the superintendent who refuses to pass any request for labor that has not been included in the budget unless extraordinary conditions demand changes in the budget estimates. The superintendent also watches the indirect labor items very closely in an endeavor to keep as high a ratio between the direct and indirect labor as is possible.

The amount of supplies to be used in the budget period is estimated from the lists submitted by the foremen and from past records of actual amounts withdrawn from stock. This figure is placed in the compilation of the budget as shown in Table 2.

The supervisor of the labor section makes up his budget in conjunction with the other sections, as the number of time clerks bears a direct relation to the number of productive workers.

He must also watch the employee requirements of all the minor detached subdivisions of the business in order to be prepared to supply help where needed. By careful planning most of the demands for increased numbers of employees can be anticipated and selective hiring instituted, thereby avoiding the disturbances arising from misfit employees.

The equipment supervisor must plan his budget in co-operation with the productive supervisor, as the number of machine repair men, tool-crib attendants, tool repair men and others is dependent upon the number of productive workers in the factory. Another factor is the tool equipment that must be made for any new products to be manufactured. These new products will require new tools and fixtures, and if a new model of the product is promised to the sales division for a certain date, the tool design department and toolroom must have enough men to produce the tools when needed.

Besides submitting the number of employees necessary for the budget period, the supervisor of equipment gives his estimate of the cost of the materials for tools, equipment, and repairs that he desires to purchase the next month. As he has the responsibility to specify and order new machinery and equipment, subject, of course, to the approval of the superintendent, he must include the cost of these in his budget. (See Table 2.)

TABLE 2. ESTIMATED MANUFACTURING EXPENSES
Manufacturing Division. Month of October, 1923

CLASSIFICATION	SUPT'S. OFFICE	PLANT	MATERIAL	LABOR	EQUIPMENT	PRODUCTIVE	TOTAL FOR BUDGET
Salaries	$1,350	$1,975	$6,275	$2,650	$1,700	$4,650	$31,600
Indirect labor	...	10,350	4,500	...	12,200	4,275	31,325
Excess on overtime	.....	50	.....	.....	.....	.....	50
General factory supplies	.....	2,100	900	50	750	4,000	7,800
Perishable tools	.....	50	.....	.....	2,200	50	2,300
Material for tools and equipment	.....	.....	.....	.....	1,800	.....	1,800
Indirect expense at outside points	....	100	.....	.....	.....	.....	100
Misc. factory expense	....	.....	100	50	50	100	300
Traveling and entertainment expenses	.....	.....	200	.....	.....	.....	200
Telegraph, telephone and postage	.....	150	160	15	.....	.....	325
Material for maintenance work	.....	2,000	.....	....	.....	.....	2,000
Spoiled work	...	...	.....	...	...	6,000	6,000
Heat and water	....	1,600	...	...	...	...	1,600
Power and light	....	3,400	...	...	...	...	3,400
Totals	$1,350	$21,775	$12,135	$2,765	$21,700	$19,075	$78,800

TABLE 3. BUDGET OF OPERATING EXPENSES
Manufacturing Division. Month of October, 1923

ACCOUNT	CLASSIFICATION	SEPTEMBER	OCTOBER	REASON FOR VARIATION
10	Salaries	$21,600	$21,600	.....
11	Indirect labor	30,200	31,325	.....
12	Excess on overtime	200	50	.....
13	General factory supplies	7,700	7,800	.....
14	Perishable tools	2,400	2,300	.....
15	Material for tools and equipment	1,200	1,800	New Blower
16	Indirect expense at outside points	25	100	.....
17	Miscellaneous factory expense	50	300	.....
18	Traveling and entertainment expense	300	200	.....
19	Telephone, telegraph, and postage	300	325	.....
21	Material for maintenance work	1,200	2,000	New roof on foundry
23	Spoiled work	5,900	6,000	.....
24	Heat and water	1,200	1,600	Fall weather
25	Power and light	2,875	3,400	.....
	Total	$75,150	$78,800	
..	Productive labor	52,000	53,500	Increased production
	Shipping containers	7,000	7,500	.....
..	Productive material purchases			
	Releases on old commitments	60,000	80,000	.....
	Releases on new commitments	21,000	76,000	.....
	Contingency	5,000	8,000	.....
..	Resale materials	40,000	50,000	.....
..	Freight and express	6,000	6,500	.....
..	Non-productive material			
	Purchases	12,000	12,000	.....
	Contingency	2,000	2,000	.....
	Final total	$283,150	$374,300	

Before the plant section can submit its requirements for the budget, it is necessary that the supervisors of the other sections notify the plant supervisor of all the work they desire done during the next month's budget period. Then he has his foremen prepare a list of the materials and the man-hours that will be

required for all the work requested. In advance of the date for submission of budget figures, a meeting of the manufacturing division superintendent and his supervisors is held to determine which items of plant maintenance work or departmental changes, etc., as requested, will be approved for next month's budget. From the approved list of repairs, new improvements, etc., authorized in this meeting, the supervisor of the plant section makes up a budget of the number of employees that will be necessary for the next month, and the material that must be purchased or drawn from stock.

The lists of materials thus prepared are priced by the purchase request department of the materials section and the totals submitted with the budget of employees to the superintendent. The purchase request department retains a copy of the lists so that the amount of supplies in stockrooms can be maintained sufficient to cover the withdrawals made by the plant section during the coming budget period.

TABLE 4 BUDGET OF OPERATING EXPENSES

Engineering Division. Month of October, 1923

ACCOUNT	CLASSIFICATION	SEPTEMBER	OCTOBER	REASON FOR VARIATION
10	Salaries	$6,000	$7,800	Developing new pump design
11	Indirect labor			
12	Excess on overtime			
13	General supplies	1,200	1,500	
14	Perishable tools	150	150	
15	Materials for equipment	100	100	
16	Indirect expense at outside points	250	300	
17	Miscellaneous expense			
18	Traveling and entertainment	200	200	
19	Telephone, telegraph, and postage	20	20	
21	Material for engineering work	100	100	
23	Spoiled work	50	50	
24	Heat and water	50	50	
25	Power and light	110	110	
26	Fuel (for gas engines)	200	350	Special engine tests
	Total	$8,430	$10,730	
	Contingency	500	500	
	Final total	$8,930	$11,230	

Items of heat and water, and power and light, (Table 2), are submitted by the plant supervisor who has charge of these necessities and collects the data through reading the meters.

The compilation of the budget for the manufacturing division is done in the superintendent's office. The data from the various sections are studied and grouped according to Tables 2 and 3. The figures of the previous month's budget are also shown so that comparisons can be made and reasons for any changes noted. Another estimate is made in similar form of the requirements for two months in advance to enable the comptroller to forecast the cash requirements and operating expenses for such a period.

The present number of employees in the various sections is tabulated together with the number estimated for the coming month. These figures are made a part of the budget, and, when compiled by the comptroller along with those of other divisions of the business, are sent to the employment manager to be used by him in controlling the number of new employees to be hired during the budget month.

TABLE 5. BUDGET OF OPERATING EXPENSES

Administrative Division. Month of October, 1923

ACCOUNT	CLASSIFICATION	AMOUNT
801	Officers' salaries	$3,100
802	Departmental salaries	6,700
803	Stationery and supplies	250
804	Telephone, telegraph, and postage	500
805	General traveling	1,000
806	Patent department expenses	1,500
807	Cafeteria	600
808	Recreation and education	500
809	Medical relief	250
810	Benefactions and donations	1,500
811	Ordinary business expenses	1,250
812	Insurance	100
813	Legal expenses	500
814	Auditing and appraisal	
815	Light, heat, and water	100
816	Maintenance of buildings	100
817	State liability insurance	100
818	Termination of employees' services	200
819	Cancellation of purchase agreements	350
820	Special adjustments	500
821	Automobile usage	100
	Total	$19,500
	Contingency	1,050
	Final total	$20,550

In the engineering division, the chief engineer is made responsible for the submission of proposed expenditures for running his department. He is familiar with the work to be done in the way of bringing out new products and the necessary improvement work to be done on current production. He should be given a classification of accounts, Table 4, and required to estimate the amount to be expended for each classification. In addition to this he must submit a detailed list of proposed purchases. The amount of these purchases is included in the expense budget. This list must be carefully reviewed by the comptroller, and if it is approved by him, it should be forwarded to the purchasing department, where, unless changed by the comptroller, it is rigidly followed.

The pay-roll of the engineering department is controlled by a statement of the chief engineer who states in his budget the maximum number of employees he will need for the budget period. Once set, this figure cannot be altered without the special approval of the comptroller.

In the finance division the treasurer of the company is responsible for the submission of proposed expenditures for the administrative end of the business. A classification of accounts in accordance with Table 5 is filled out and forwarded to the comptroller. The expenditures for purchasing supplies, etc., and for the pay-roll, can be controlled in the manner explained above for the engineering division.

The inspection division reports directly to the general manager and not to the head of the manufacturing division. Thus it follows that the same kind of information for budget purposes is required from the chief inspector as is needed from the chief engineer, and the same methods of obtaining it and maintaining a check on it are used.

Developing the Sales Division Budget

The sales manager, knowing that the comptroller has statistics available from which the budget estimates were made up, consults with him in arranging

his program for the coming year. To the sales division, actually, is given the real task of making the general manager's plans effective, for no matter how many units of product the manufacturing division may turn out each month, the profit on them is not assured until they are sold. So the sales division must sell the quotas decided upon by the general manager and comptroller. Moreover, the efficient operation of the factory depends on maintaining steady production in large quantities, and this condition reverts back to the ability of the sales force to sell in large quantities.

The sales manager may desire to hold conventions, group meetings etc., and must estimate the cost of these items so that they may be included in his budget allowance. He must also add the expenditures proposed for the entire sales division.

Advertising Mediums

The expenditures for advertising must be so placed that the best results in sales will be forthcoming. From the data collected by the comptroller, the best advertising mediums must be selected through which to push the sale of the products. Magazines, newspapers, and direct mail advertising must be valued in their ability to circulate among the greatest number of people, among those that have the actual buying power, and for other effective factors. The comptroller has made his estimates from information on these points, and the sales manager, with these possibilities in mind, makes plans for his selling force to secure the desired results.

The sales department should furnish the comptroller's office with an expense budget made out in accordance with the set form of classification of expenses as furnished by the accounting department, such as Table 6. A statement of the maximum number of employees to be on the sales department pay-roll for the budget period must be furnished. In addition to this, a list of proposed purchases is also made and when approved by the comptroller is passed on to the purchasing department where it is handled in the same manner as lists from other divisions. In the sales department a greater contingency amount should be carried than for other departments on account of uncertainties peculiar to this division of the business.

The sales order, advertising, and service departments furnish similar records of proposed expenditures on a set form provided by the accounting department. These records are handled in the manner explained under the sales department. Table 7 shows an expense budget for the advertising department.

Control of Office Supplies

The office supply department is held responsible for the maintaining of an adequate stock of office supplies for the factory and offices. The department is required to submit to the head of the sales division a list of these supplies to be purchased, showing their estimated cost. This list, when approved by the comptroller is passed on to the purchasing department where it is used to check against the purchase orders as they are requested by the office supply department. In order

TABLE 6. BUDGET OF OPERATING EXPENSES

Sales Division. Month of October, 1923

Account	Classification	September	October	Reason for Variation
201	Salaries	$4,800	$4,800	
202	Traveling	2,000	2,800	Conventions
203	Stationery, supplies, etc.	297	300	
204	Telephone, telegraph and postage	1,000	1,000	
205	Printed matter	8,500	7,000	
206	Conventions and schools	2,000	3,000	Conventions
207	Special field adjustment	1,000	800	
208	Prize contest	1,300	1,000	
209	Special field expenses	1,000	750	
210	Automobile usage	300	300	
215	Miscellaneous expense	100	150	
	Total	$22,297	$21,900	
	Contingency	2,000	2,500	
	Final total	$24,297	$24,400	

TABLE 7. BUDGET OF OPERATING EXPENSES

Advertising Department. Month of October, 1923

Account	Classification	Item	Amount	Totals
24 A	Direct mail	50,000 each direct mail pieces	$5,000	
		50,000 envelopes	404	
				$5,404
24 B	National magazines	Country Gentleman	3,500	
		Art work and plates	150	
				3,650
24 C	Co-operative newspapers	Campaign—St. Louis territory	228	
		Campaign—New York territory	175	
				403
24 D	Advertising literature	50,000 special folders	485	
		Art work	160	
				645
24 E	Posters and signs	Signs at County Fair		85
24 F	Window displays			125
24 G	Films and slides	4 Educational films	742	
		3 doz. special slides	35	
				777
	Total			$11,089

to control the making up of new forms, both for the factory and the office, the comptroller must require that all orders for such printing be approved by him before being sent to the purchasing department.

The service department, in addition to furnishing records of proposed expenditures similar to those submitted by the sales division, must furnish a complete list of service parts to be purchased during the following month. This list is calculated in dollars and submitted to the comptroller for approval, after which it should be forwarded to the purchasing department to be used to check against the purchase orders as they are released throughout the month. The invoices for service parts as they are received are classified by the accounts payable section under the head of service parts, and this record is also used as a check against the releases given by the purchasing department.

All these various budgets must be submitted to the comptroller not later than the twentieth of the month preceding the month for which the budget is being compiled, and a comprehensive study of each report is made as soon as it is received, in order to accomplish the purposes of the budget system. How these budgets are analyzed, and how the operations of the various divisions of the business are controlled through the work of the comptroller, will be discussed in the next article.

(To be continued in the February issue.)

Cost of Carrying Overdue Accounts

By J. W. HALLMAN

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Index Number
658.88 Collections
657.5244 Overdue sales accounts

STATISTICS of business failures in the United States compiled by The Bradstreet Company show incompetence and lack of capital to be the causes of failure in 65 per cent of the cases recorded. "Incompetence and lack of capital" are very broad, general terms, but, in reviewing many businesses in difficulty throughout the United States and Canada over a period of years, I have found that almost invariably the terms so used are localized and concentrated in an unduly swollen "accounts receivable". "If our customers would pay us, we could pay you," is an excuse that has been repeated many times by business houses in difficulty, and usually it is quite the truth. But, what if they do not pay?

"Accounts receivable" is, to my way of thinking, the best success or failure barometer a business house can have. If accounts are not paid there is always a reason for it, and the credit manager who analyzes and classifies his outstanding receivables should have no difficulty in keeping his accounts receivable active and liquid.

The reasons for non-payment of accounts are frequently not chargeable to improper extension of credit, but it is still the job of the *real* credit manager to know why accounts are unpaid, and to set in motion such agencies in a business as will correct the cause, or causes, of congestion in the "accounts receivable".

Where accounts receivable are kept in the proper ratio with sales and terms, there you will usually find the treasurer of a concern able to discount his supply bills, the concern to have a first-grade credit, and incidentally (often in some obscure corner) a man who has learned to handle credits and collections properly.

Should it not occur to one, then, that interest on overdue accounts is frequently chargeable to branches of a business other than the credit and collection branch? Bradstreet's statistics, covering businesses that have failed, prove this when they find only 1 3/10 per cent of failures due to unwise extension of credits. And, in the case of businesses that have not failed, if it were possible to compile correct data, the cost of carrying overdue accounts, when analyzed and classified by cause and effect, would find lodgment for the most part outside of the credit and collection branch. Unfortunately, too, many so-called credit men in the past, through their own incompetence, have been unable to put their fingers on the precise cause, or causes, for their predicament, and so have often had to assume responsibility that was not properly theirs.

There is only one successful way that I know of, by which this feature of credit and collection work can be properly handled. Of course, correspondence and close scrutiny of records of accounts will permit one's handling properly the great majority of customers. But, in almost every business, there are accounts that cannot be handled in that way. These are the ones that accumulate, that unduly enlarge the "accounts receivable," and if permitted to remain there too long will become losses to the business—perhaps ultimately ruin the business.

Here is what we have done, more or less successfully. By using the special records to which I referred in an earlier issue,[1] we are able to select in a given territory the accounts that are behaving stubbornly as to liquidation. When a number of these appear, or one of sufficient size, to justify the expense of a trip into that territory, I take these cases and call on the customer personally. This, in the past, has usually resulted in settlement of the account and a continuance of our business relations. I have also often secured considerable new business on these trips.

But apart from settling a particular account, or accounts, and perhaps getting some new business, it enables us to get the customer's viewpoint on our house, our goods, and our methods. When there is something wrong with ourselves (the customer is not always wrong when he fails to pay an account) the information is given to the proper department, the necessary remedy applied, and the account is usually once more numbered among our active, liquid accounts receivable.

The "Shock Absorbing Account"

Sometimes, though, there are difficulties to be overcome that take a little time in working out. And this frequently causes embarrassment on the part of some creditors. I believe it not amiss, at this point, to say a word on behalf of the credit man who is always criticized and condemned for insisting upon immediate settlement of his account. This fellow always comes in for a lot of "hard feelings" from other credit men interested in an account, and frequently quite justly so, if pure selfishness actuates his stand. But there is a plausible reason also for that stand on the part of some. That very house, whose representative insists upon prompt payment, to the detriment of an extension agreement, may itself be embarrassed by delay in the payment of the account, and yet that credit man dare not say so for the welfare of his own concern. It is harder to suggest a remedy for his embarrassing position than a preventative. He could, of course, in that predicament, consistently and perhaps without harm, insist that the extension be given by taking interest-bearing notes, which his firm could discount, and in that way have immediate use of the money. But a

[1] See MANAGEMENT AND ADMINISTRATION for October 1923, p. 473.

better way is always to be prepared for such an emergency. How may this be done? By making proper use of the "shock-absorbing" account mentioned in my previous article above referred to.[2] And to keep this account within proper bounds, it is necessary to detect and correct unnecessary causes for delays in payment of accounts so it may represent for the most part accounts that have necessitated extensions for constructive reasons only.

Helping the Sales Department

Right here I am reminded of a question raised by a friend of mine, a few days ago, as to my statement that this account, if properly handled, can be made "a real servant of the customer, the sales department, and the management." He wanted to know how it could be made to benefit the sales department. I answered by citing a case that came up recently:

A customer owed us about $9,000, owed a competitor of ours about $12,000, a tire company about $20,000, his bank about $50,000, as well as smaller amounts to a number of other creditors. An extension agreement was entered into and the debtor lived up to his agreement splendidly, until our account had been reduced to about $1,000 and other accounts proportionately. The salesman in that territory had been trying to get back his trade, but on account of his financial condition and a question of distance and tank storage the odds were against him and he lost out on all his efforts to sell. I visited the customer and made an arrangement that makes the account just as safe as any on our books, sold him a car of material, and put him in a position to handle our goods again advantageously, at the same time in no way jeopardizing his position with co-creditors. An auditor in checking such accounts receivable would doubtless brand them as "overdue," but a business builder will have no difficulty in appreciating the value of such accounts.

So when our general sales manager several years ago asked me how much it was costing us to carry overdue accounts, it seemed only natural for me to answer his question along the following lines:

If I were to answer that question literally, I would say that our accounts running over our usual term period amount to an average of so many dollars, which at a 6 per cent rate of interest amounts to so many dollars. But, I believe, in answering this question, we should first consider why accounts are overdue. If accounts are overdue because of something in our own organization that should be corrected, then overdue accounts are costing us money, and are a needless expense. But if accounts are overdue because of conditions outside of our own organization, conditions that do not fit our standard methods and policies, conditions that would otherwise eliminate the possibility of having this trade on our books, then I believe overdue accounts are costing us nothing (if kept within due bounds) and tend to increase our volume, which in turn, if profitable business, must naturally tend to reduce general overhead expenses. If we look at these overdue accounts from a viewpoint of constructive business building, they can be made a very profitable feature in the conduct of any business (if properly handled, of course.)

There are many instances when an overdue account can be profitably carried. For example, a customer of ours several months ago came into our office and showed us that he was short on working capital temporarily, due to conditions really beyond his control. His account was overdue, and he needed more material. A short-sighted collector frequently insists upon payment of such accounts. Under circumstances such as existed in this case, he is usually paid, and the customer seeks a new source of supply. But we gave him an extension for payment of the then overdue account, evidenced by interest-bearing notes, and he agreed to pay for current purchases strictly according to terms. In cases of this kind the customer is grateful for the lift; it is, moreover, a long step toward removing competition.

The successful handling of accounts of this kind is a matter of good management. It demands careful consideration of all things involved in the situation, with an eye on the constructive effect of the transaction. Indifference, laxity, soft-heartedness, or carelessness may mean disaster. These transactions demand foresight and keen business acumen. They are problems that no inexperienced clerk should be permitted to handle, nor should a house refuse to handle them altogether as is often the case, to the detriment of its own best interests.

At a luncheon meeting of a business men's organization in New York City a few days ago, a nationally prominent credit man was introduced as the speaker for the day, with the comment that if all business men were members of that organization there would be no further need for credit men. Just that attitude toward credit men in the past had been detrimental to the best interests of business, and the proper, intelligent use of credit in many cases.

Keep Good Credit Men on the Job

The experience of years gone by has shown that in many cases when a credit man develops to a point where he is really a valuable adjunct to a business, he is given a better job, and the whole proposition slips back to a clerkship, with unfortunate results. That is, perhaps, why there are so many so-called bad debt losses in business, why credit men are sometimes spoken of with more or less disdain, why they are sometimes looked upon as a necessary evil in business—a liability rather than an asset.

It is good business to have some overdue accounts. Not to have, often means too strict a "debit and credit" interpretation of the facility of credit, and a loss of some good business. But, let me once more emphasize, they must be properly handled, and not permitted merely to "drift." It involves, sometimes, a lot of responsibility for the credit man, and is usually the means of proving whether he is merely an automaton in his organization, accepting and rejecting risks by rule of thumb methods, or whether he is a constructive vitalizing force—a real business builder.

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[2] See MANAGEMENT AND ADMINISTRATION for October 1923, p. 473.

Application of Charts in Industry

Management Data Summary—Number 22*

By DAVID B. PORTER

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Index Number

658.53 Graphic charts

MANY kinds of relationships that exist in an industrial establishment may be conveniently pictured by a type of chart properly called the box chart because it usually consists of little boxes connected by lines. The applications of such classification and route charts are many, but a few will suffice to illustrate the principle.

The most common is the organization chart, a sample of which is shown in Fig. 1. Here is presented the organization of a factory from superintendent down to workers. The heavy lines represent the lines of authority and responsibility. The dotted lines show the contacts which exist between various departments and agencies of the factory. In fact, a greater volume of transactions may flow along these dotted lines in the course of discharging purely routine duties, than flow through the heavy lines. However, when extraordinary circumstances arise outside of a routine nature, the matter should be referred through the channels of authority as represented by the heavy lines. Such charts are effective when displayed in shop offices so that employees may see their relations to others in the organization.

The detail of routine matters may be conveniently shown by a chart like Fig. 2.[1] This chart is readily adaptable in any kind of business or industrial organization at points where contacts exist between employees in the conduct of their work.

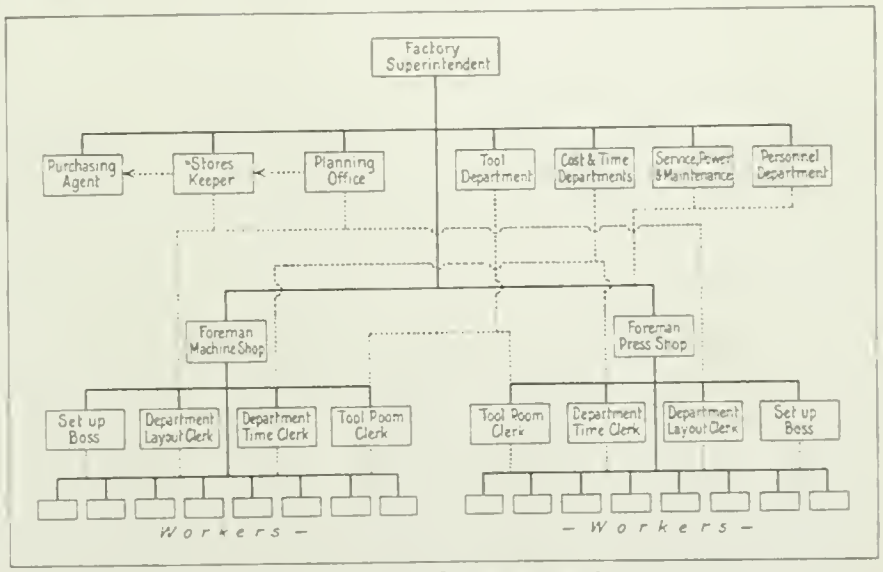

FIG. 1 FACTORY ORGANIZATION CHART

A graphical picture of an assembly of manufactured parts is sometimes useful in the planning and production offices where work is scheduled for machines. Fig. 3 is a chart showing the assembly of a base detonating fuse. It tells at a glance just what parts are needed for each subassembly and what other parts are needed with each subassembly to make a major assembly, and finally what major assemblies plus additional single parts are needed for the final assembly. This can be amplified by writing on it the lists of operations which are necessary on each piece and for each assembly. Such information is needed by the layout clerk.

Fig. 4 illustrates an entirely different application of this type of chart which is of use in accounting. Here each box represents some account or group of accounts. The process of clearing the accounts at the end of the fiscal period is indicated by the lines and arrows which indicate how the accounts are cleared step by step from one to the other until the final stage is reached.

The bar family of charts has artistic possibilities, therefore it possesses those qualities which attract attention and make a strong appeal for advertising purposes. However, the uses which are found in management are very limited. The simple bar chart[2] is excellent for presenting relative magnitudes of statistical data. The more complex forms are probably of greater use in the field of management. Fig. 5(a) is an absolute compound-bar chart showing the distribution of total revenue into expenses, dividends, and balance, for the years 1921 and 1922. The breaking down of a total into its parts so that each part is seen in relation to the total is perhaps the best use of the bar chart. If only the year 1921 were to be shown, the left-hand bar of Fig. 5(a) would be entirely sufficient to convey the information. Two years are shown for purposes of drawing a comparison, and we now find that all the information cannot be derived from Fig. 5(a).

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* This article is one of a series which gives in concise, factual form standardized methods and accepted practice generally applicable in industrial operations.

[1] For a full description of this chart see *Management Engineering*, May 1922, p. 281, "Charting Authority and Responsibility to Show Complex Management Relationships," by Boyd Fisher; also *Management Engineering*, April 1923, p. 223, "The Use of Routine Charts," and June 1923, p. 389, "Routine Chart Construction," by G. Charter Harrison.

[2] This does not include the Gantt Chart, which in one sense is a bar chart. The Gantt Chart will be treated by itself in a later article.

○ Originated by — × Information by — △ Sent to — ⧖ Approved by —	Superintendent	Purchasing Agent	Planning Office	Dept. Layout Clerk	Stores Clerk	Foreman	Time Clerk	Tool Room Clerk	Set up Boss	Maintenance Dept.	Move Man	Pay Master
Shop Order	⧖		○	△								
Srores Order			○		△							
Tool Order				○				△	×			
Move Order				○		⧖					△	
Repair Order				○		⧖				△		
Purchasing Requisition		△			○							
Pay Roll	⧖					⧖	○					△

FIG. 2 DETAIL OF ROUTINE ORGANIZATION

We see that the operating expenses increased in 1922 by a certain amount, but the question at once arises: "Did these expenses increase in the same proportion as the revenue increased?" Fig. 5(b) answers this question. It is a relative compound-bar chart in which the several items are reduced to percentages of the total. We at once see that the operating expenses declined proportionately in 1922. It is proper to place these two charts side by side when data of this kind are presented.

If the chart is to be extended over a period of years, additional bars may be added, but in so doing a good deal of its clearness is sacrificed. It is better to drop the bars and erect thin lines to represent each year, and plot points to show where the divisions of the bars were, and finally to connect the points by straight lines which gives us a series of curves instead of bars. Sometimes the areas between the curves are colored or shaded, but this is dangerous in any chart showing absolute amounts because it attracts too much attention to the areas, which become very much distorted when high peaks and deep valleys occur in the top curves of the chart.

The relative or percentage chart does not have quite such extreme ups and downs in its curves, since the top is always 100 per cent and at a constant level, therefore coloring and shading may be employed for effectiveness without too much distortion. An excellent use of the relative bar chart is to show production in per cent of rated capacity, or sales in per cent of the sales quota. If curves are used instead of bars the production of several plants or departments may be combined on the same chart, where each production curve is shown as a percentage of its department's particular rated capacity. In this way valuable comparisons may easily be made between the production performance of the different departments. The same method is applicable for comparing the sales of the different districts.

When the bar chart is used to show parts of a whole with no reference to time, it is sometimes drawn in the horizontal position. However, it is well to adopt the vertical position because it conveys the idea of piling parts on top of each other in order to reach the total. The vertical position is the correct one when a time series is charted, because time is generally plotted along the horizontal scale, and finally when bars are replaced by curves the vertical scale is used for the plotting of the points. This makes the transition from reading bar charts to curves easy and consistent because magnitudes are read from the base upward.

A word of caution is timely here. No one would consider for a minute cutting off the bottom of the bars in Fig. 5 to save space, just because the operating expense portion of the bar was long. Yet this is exactly what is done when one cuts off the zero line on a chart when the curves happen to lie in the upper portion of the field.

The pie chart, so-called from its circular form, is used to represent the composition of parts into a whole or 100 per cent. Such information is more simply presented by the bar chart described above, therefore we find no place for the pie chart here, and relegate it with its brother, the picture chart, to the realms of advertising and for the presentation of statistics for popular consumption.

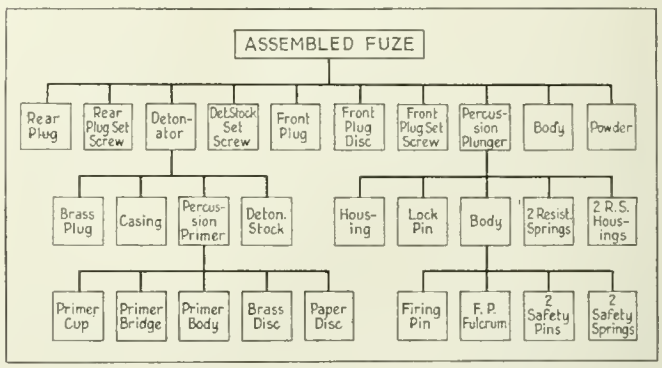


FIG. 3 ASSEMBLY CHART FOR COMPONENTS OF A FUZE

Historical Charts

The field of historical charts in management is very broad and it is impossible to include in this limited space all of the possible applications which exist. A few tried and approved types of charts which have become practically standardized are presented, and other applications are suggested, so that the reader can make the proper selection of type to suit his particular needs. The charts described in this group are primarily for the executive who is concerned in making analyses of business statistics for the purpose of determining administrative policies.

Fig. 6 is a simple chart showing one factor, sales, by months over a period of years. The data are taken from a national industry and are altered without disturbing the correct relationships in volume of sales. In making a chart of this kind it is well to include the data themselves in the manner shown at the top of the field. In this figure much of the field between zero and 1500 has been cut away in order to save space in the printing. In practice this should not be done because it gives a false impression as to the relative magnitude of the fluctuations.

The dotted curve is plotted from the 12 months' moving average. The points for this curve are obtained by dividing the total amount of sales for the first 12 months by 12, and then dropping the first month, adding the thirteenth month and again dividing

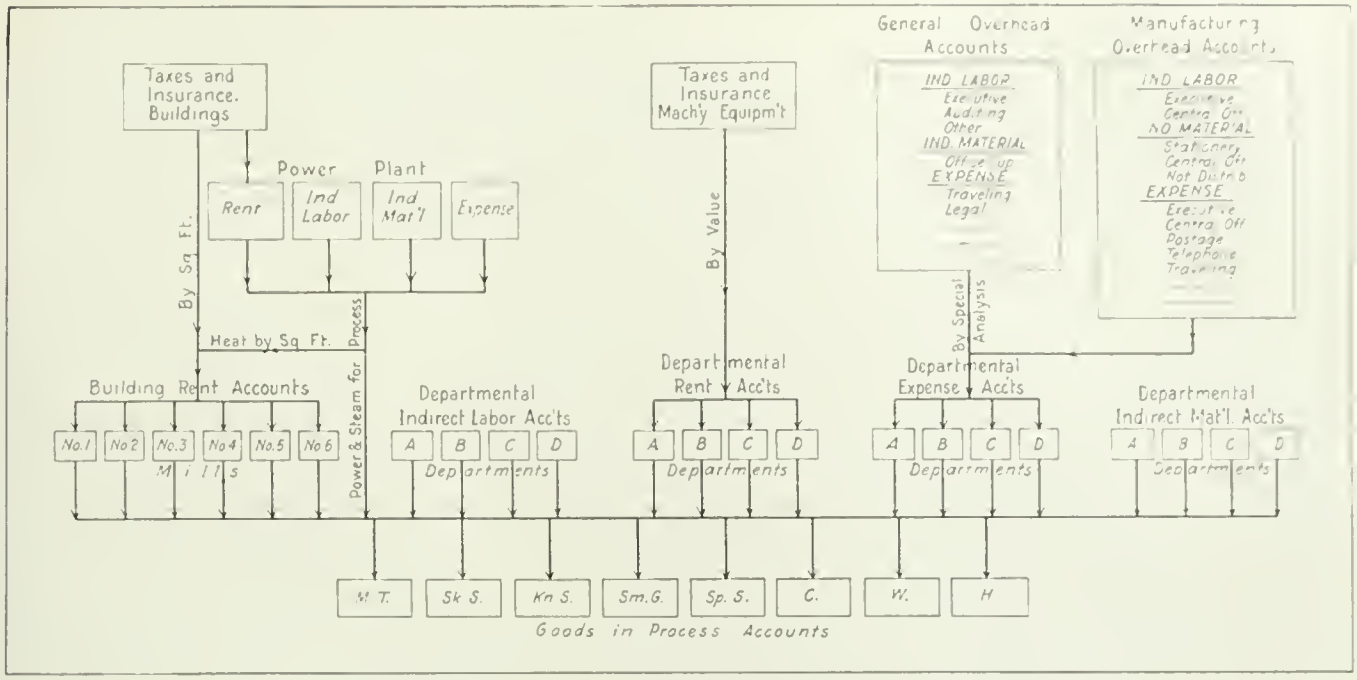


FIG. 4 CHART FOR CLEARANCE OF INDUSTRIAL ACCOUNTS

by 12, and proceeding in like manner throughout the series of months. A question arises concerning the proper place to plot the first point. If we wish to show the moving average in its proper relation to time, the point representing the first 12 months should be plotted at the center position of the 12 months' interval. However, it has become approved practice to plot the point at the end of the 12 months' interval. When this is done it must be read as the average for the past 12 months. This method is excellent for smoothing the irregularities of the monthly fluctuations, and for bringing out the trend.

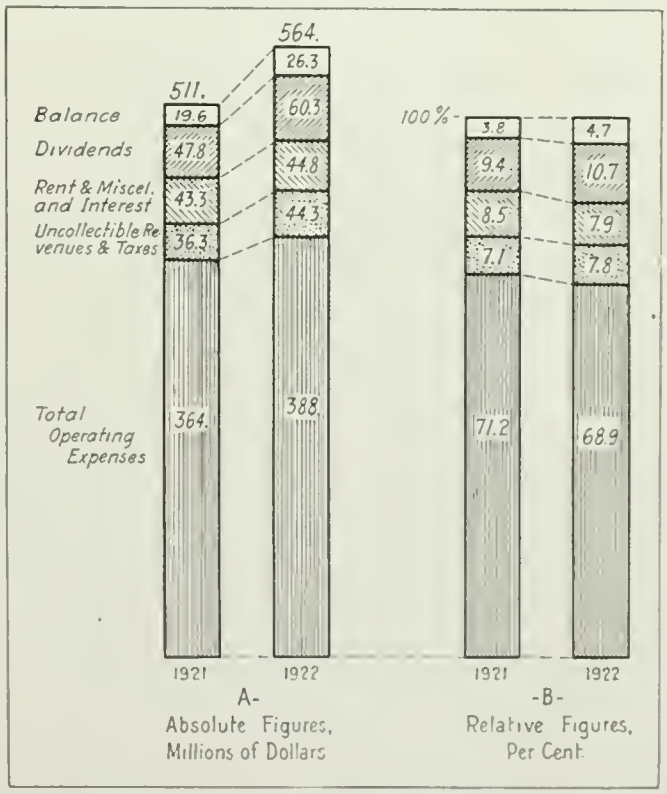
Such a chart becomes more valuable when it is extended over many years. A longer perspective is obtained which is an aid when the chart is studied for the purpose of estimating future movements. This type of chart is suitable for presenting in condensed graphical form a historical record which extends over a period of years and which fluctuates widely. The chart becomes too confusing when more than one curve is plotted with its moving average if the curves cross each other many times.

It is often desirable to study the behavior of the monthly fluctuations, and to have them isolated from the influence of the general trend. This may be shown graphically by plotting the deviations of the monthly curves from the moving average at the same point of time as plus or minus quantities according to whether the monthly points are above or below the moving average. Another way is to plot the monthly points as percentages of the moving average points.

Attention is called to the proper place for the moving average curve. When it is employed as just described, the first point of the 12 months' moving average series must be plotted at the center position of the first 12 months' interval so that the curve will be correct in its position with respect to time.

The year has been used in Fig. 6 as the interval of time for which to compute the moving average. This is entirely arbitrary; another period could be used, but the year is characteristic of the cycle of many business events and is commonly employed.

Fig. 7(a) illustrates a method of analysis from a different point of view. It is often desired to know how the sales for some particular key month have varied over a period of years, and to compare these



Source: Annual Report of American Telephone and Telegraph Company

FIG. 5 DISTRIBUTION OF ITEMS OF INCOME COMPARED BY TWO METHODS

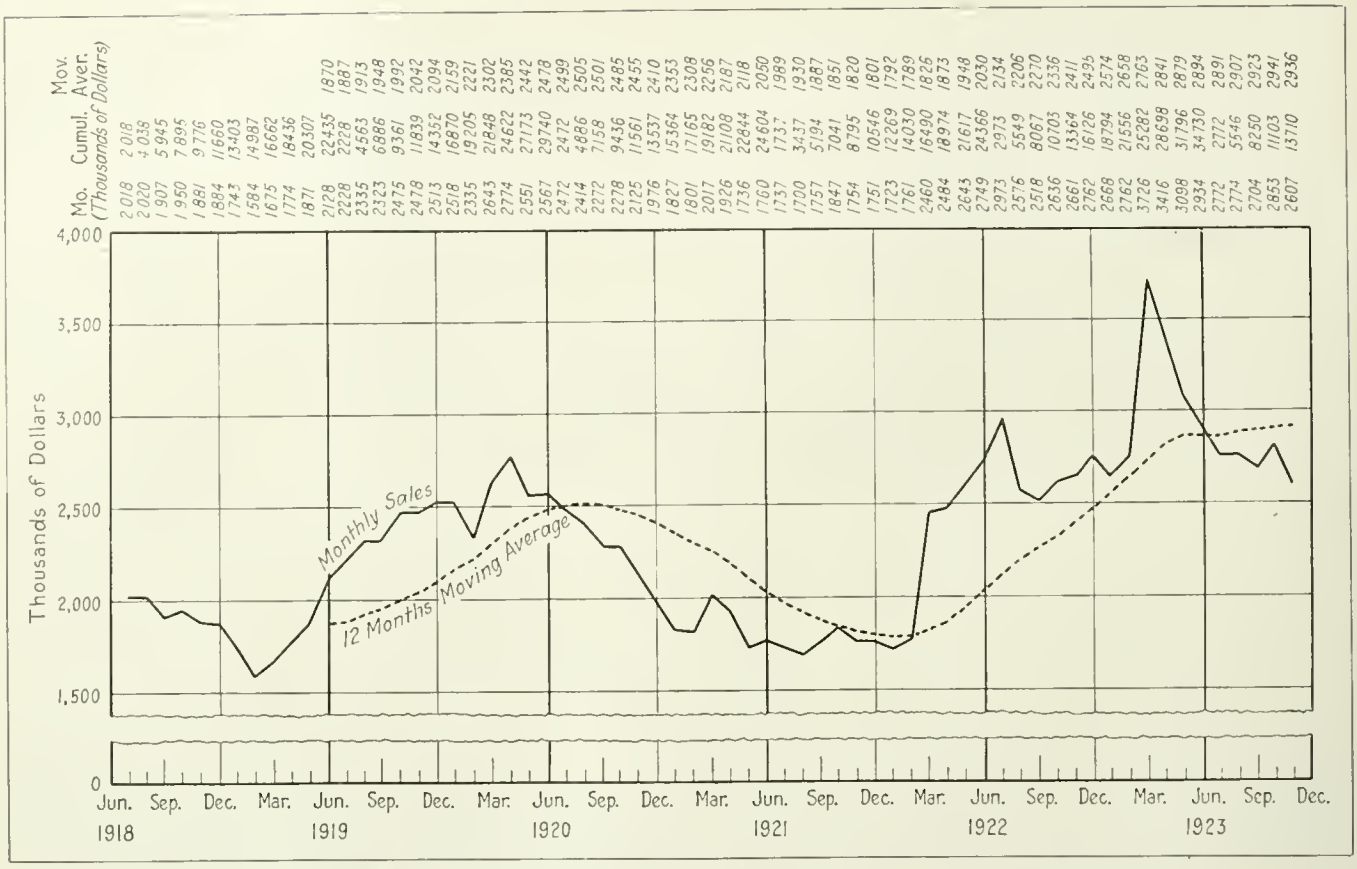


FIG. 6 MONTHLY SALES AND 12 MONTHS' MOVING AVERAGE, SHOWING TREND

with the preceding month in each year. The years are laid off in Fig. 7(a) on the horizontal scale and the sales for March of each year are plotted and connected by straight lines. The solid line shows how the sales went up and down for the months of March over the series of years. The sales for each February are also plotted and the points connected by a dotted line. It will be seen that in general the February sales had the same characteristics and also that in each year they were below the March sales.

Fig 7(b) shows the total sales for the 12 months ending with March of each year, and, used in conjunction with 7(a), it may be seen whether the total for the year ending with March follows the monthly trend for March from year to year.

From still another viewpoint it is desired to know the cumulative total from the beginning of the year or fiscal period to the end of any month, and also to be able to compare this total with the same total for any other year. The ordinary type of cumulative chart, with the curve rising from zero at the beginning of the period and passing through the cumulative total at the end of each successive month, is satisfactory when curves for not more than four or five years are drawn upon the same chart field. A greater number of lines leads to confusion and obscurity, especially when the lines cross each other.

A very good chart which allows for indefinite extension has been devised by Percy A. Bivins [3] and is shown in Fig. 8. The years are laid off on the horizontal scale and the amount of sales for the first month of the period (in this case July) is plotted on the ver-

[3] For details see *Industrial Management*, May 1922, "Charting as an Aid in Stabilizing Profits," by Percy A. Bivins.

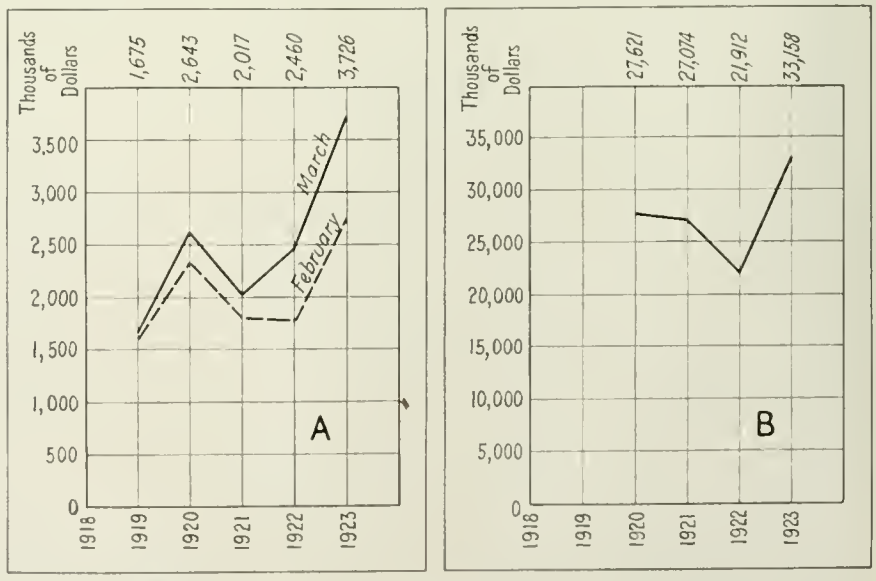


FIG. 7 (A) MONTHLY SALES DURING MARCH COMPARED WITH FEBRUARY, 1919 TO 1923. (B) TWELVE MONTHS' SALES ENDING WITH MARCH, 1920 TO 1923

tical line for each year. Upon the July sales are plotted the August sales so that the curve labeled August represents the total sales from the first of July to the end of August. The chart is built up in this manner until the last month of the period, June, is plotted, which represents the cumulative total for

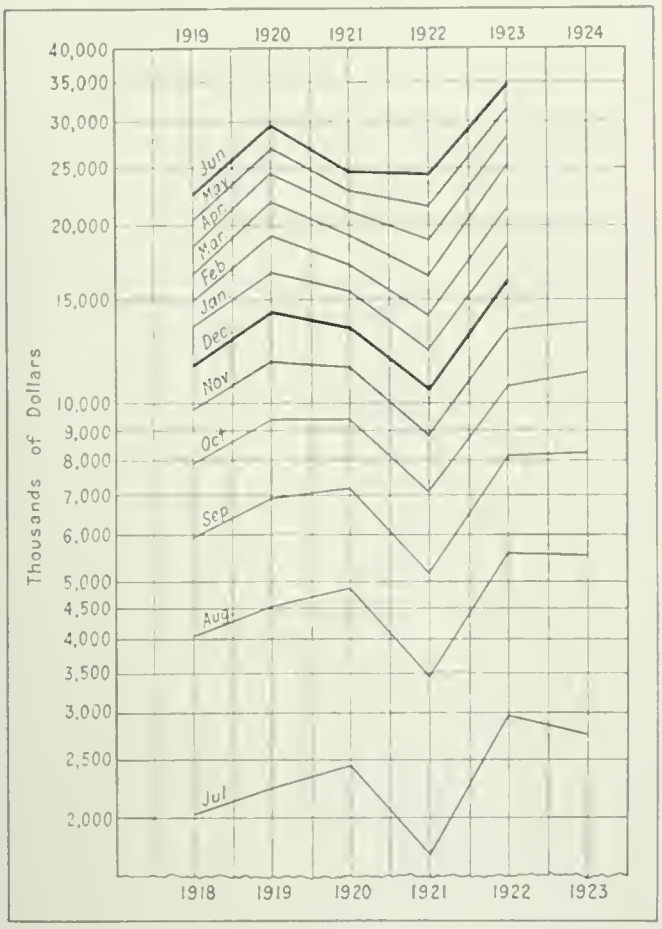


FIG. 8 CUMULATIVE CHART OF SALES ALLOWING FOR INDEFINITE EXTENSION

the year. It will be seen that the lines never cross each other and any cumulative total may be easily read and compared with any other cumulative total for any year.

There is another special feature about this chart. It is drawn on a rate of change or logarithmic scale. Therefore the curves must not be read with reference to the base line, but their slopes must be read with reference to each other. If an amount of change or arithmetic scale had been used, the peaks and valleys of the top lines would have been so much more exaggerated than those in the lower lines that a false impression of their relative magnitude would have been gained. Since it is percentage changes that we wish to know, the rate of change scale presents them in their true relationship no matter if we are comparing one month with the totals for 12 months.

Let us again examine the data of Fig. 6 from the point of view of a simple historical series, and chart the sales for the year ending June 1923. This time we will plot the monthly sales for each month from July 1922 to June 1923, the cumulative sales beginning and ending with the same months, and the moving annual total for the same period, and we have what is called a Z chart, Fig. 9.[4] In order to bring the cumulative and moving annual total curves within the bounds of a chart which shows a monthly curve, a different scale is used for plotting these two curves. The scale for plotting the monthly curve is five times larger than the scale used for the cumulative and moving annual total curves. If the chart were drawn to show a year of 52 weeks, the weekly scale would be twenty times the cumulative and moving annual total scales, and if a month of 31 days is charted, the daily scale is ten times the cumulative and moving monthly total scales. In order to make the monthly curve stand out it is plotted in black and its scale and data are entered in black figures. The cumulative and moving total curves are drawn in red and their scale and data entered in red. One of the important features of this chart is its standardization as to size of paper, size of field of chart, selection of plotting scale, position of the field on the paper, location of the data themselves, and the title and accounting information. Fig. 9 shows the chart with data and scales as it appears on an 8½ by 11 in. paper, with the accounting information cut away at the left.

The accounting information, scale figures, columnar captions, and data are all typed with one vertical setting of the sheet in the typewriter, which should be equipped with a red and black ribbon. The scale figures in practice are turned around from the position shown in Fig. 9 so that they can be typewritten at the same time and read in the same direction as the other data. The scale for the moving total and cumulative curves is better placed at the left of, and close to, the scale for the monthly curve. The margin at the right of the chart field and the bottom margin then can be made no more than one-quarter of an inch in width for purposes of joining and comparing charts.

The Z charts permit of three important comparisons. Historical comparisons may be made by joining the curves for several years by lapping them together so that the chart fields come end to end with only the narrow margin of the border separating the years. Seasonal comparisons are made by placing one chart above the other so that the months are in alignment. Perhaps the most important of all are the analytical comparisons which are made by placing the chart of one subject on top of the chart of another subject, with the fields exactly coinciding, and looking through them against the light. This is facilitated if the charts are drawn on translucent paper. By such analysis important relations are easily discovered and made clear between various business and industrial phenomena. The system of plotting only one subject on a sheet makes it possible to make up any combinations of curves for this method of analysis.

In order to make correct analytical comparisons between different subjects possible on an amount of change or arithmetic scale, careful consideration must

[4] For a complete description and working details of the Z chart see *Management Engineering*, September 1921, p. 153, "Standardizing the Z Chart," November 1921, p. 283, "Comparability of Executive Control Charts," and December 1921, p. 365, "Scale Selection for Z Charts," by Arthur R. Burnet.

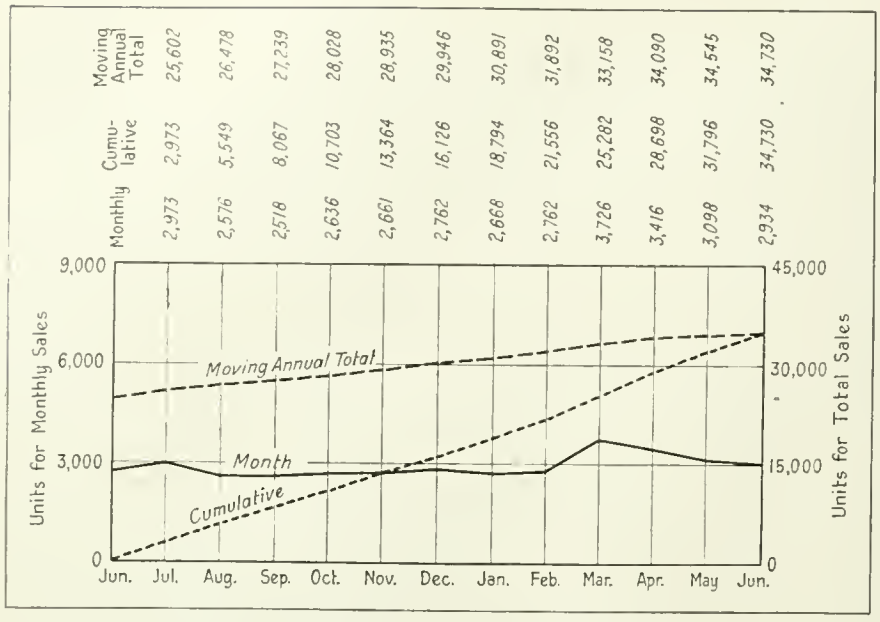


FIG. 9 A CHART OF SALES ENDING JUNE 1923

be given to the selection of scales for each chart. The effectiveness of these comparisons is based on the theory that correct comparisons can be made between two curves on an amount of change (arithmetic) scale only when both curves lie at approximately the same height on the chart field.[5] This method combines the advantages of the logarithmic scale for rate of change analysis with the advantages of the arithmetic scale for amount of change analysis so long as the curves remain at approximately the same height. If the curves grow apart in course of time they may be brought together again by selecting new scales. When this is done there is the disadvantage of breaking the continuity of the historical record by a change in scale.

A very useful feature of this chart is its use in forecasting a few months ahead toward the end of the year or fiscal period. Since the cumulative and moving annual total curves are more regular in their progression than the monthly, and since they always come to the same point at the end of the chart, they may be extended by trial over the last three or four months with a fair degree of accuracy.

In some offices it may not be desirable to go into the charting business as extensively as the Z system implies, with its individual historical series of charts for each subject, and the technicalities of scale selection, together with its plotting paraphernalia. There are times when we wish to chart related subjects on the same paper, and make correct analytical comparisons. Fig. 10 shows subjects concerning the growth of the Bell Telephone System plotted on an amount of change (arithmetic) scale. The data are entered at the top of the chart, and the various scales are shown at the left. This chart must be used to read the *amount* of change taking place in the various subjects. If scales had been chosen so as to bring all curves at approximately the same height, the curves could then be compared for their *rates* of change, but this would have rendered the chart nearly useless on account of the confusion of lines. This chart correctly shows the amount of change, but too often we are apt to slip over unconsciously into the rate of change comparison by looking at the slopes of the lines. Should we make this error in reading Fig. 10, we would say that revenue rises faster than expenses, that telephones and plant rise faster than both revenue and expenses, and that the average daily messages increase more rapidly than the number of employees.

In Fig. 11 the same data are plotted on a rate of change or logarithmic scale[6] which permits comparisons to be made between the slopes of lines wherever they may lie upon the chart field. When one line is seen to be rising more rapidly than another, which is the same thing as saying it has a steeper slope, it is increasing at a greater percentage rate than the other line. It is very important to compare the growth of many business subjects on a percentage basis, as for example, the percentage growth of expenses as compared with income. If we read Fig. 11 in this light we see that expenses rise more rapidly than revenue, that both revenue and expenses rise faster than telephones and plant, and that the employees increase slightly more rapidly than the average daily messages, which is exactly opposite from the conclusions drawn from reading Fig. 10. In the same way, in Fig. 10 the plant appears to be rising much faster than the number of telephones, while in Fig. 11 the increase of plant very closely parallels the increase in telephones.

The rate of change chart has a decided advantage over the amount of change chart in showing growth. Since most natural and social phenomena are growing by an increase of per cent instead of by a constant fixed increment, the charting of such growth on a rate of change scale will approximate a straight line, whereas plotting it on an amount of change scale will produce a curve, and the fact that the growth is almost uniform will be more difficult to recognize.

The percentage scale at the right of the chart field in Fig. 11 is used when it is desirable to know the change in per cent that has taken place. The per cent of increase over any period of time may be easily found by using a pair of dividers. Place one point of the dividers on the curve at the beginning of the period and the other point of the dividers on a point vertically above the first point and at the same height as is indicated by the curve at the end of the period of time. This measures the vertical increase in the amounts between the two dates. The percentage increase may now be read from the percentage scale by placing one point of the dividers at zero on this scale and laying

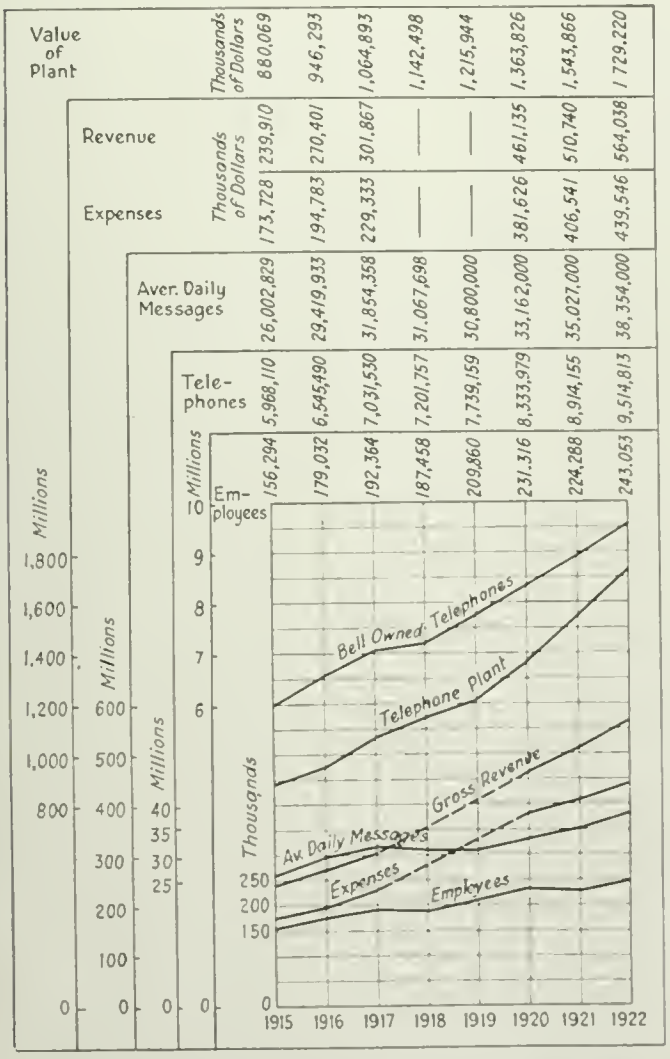
[5] For details see *Management Engineering*, December 1921, p. 365, "Scale Selection for Z Charts," by Arthur R. Burnet.

[6] For further details of this type of chart see *Industrial Management*, July to October 1921, "The Ratio Chart and Its Applications," by Percy A. Bivins; and *Industrial Management*, November 1923, "The Semi-Logarithmic Chart," by Allan C. Haskell.

off the distance as measured by the dividers in an upward or positive direction. A percentage decrease may likewise be found by measuring the amount of decrease with the dividers and laying off the amount on the percentage scale from zero in a downward or negative direction.

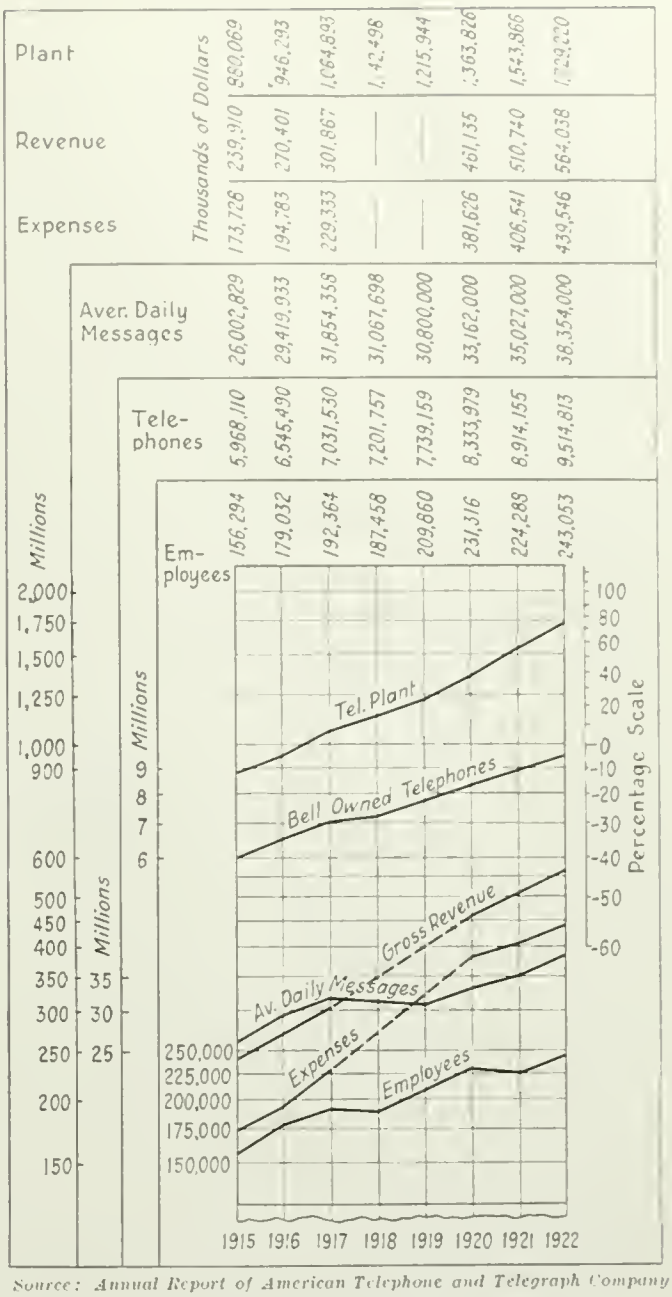
The percentage scale may be constructed from the logarithmic ruling without any additional calculations. In Fig. 11, zero on this scale is placed opposite 1000 million, which might just as well be considered 10 or any power of 10. Since an increase from 1000 to 2000 million is a 100 per cent increase, the 100 per cent mark lies opposite the 2000 million ruling. By the same reasoning the 90 per cent mark is opposite 1900 million; the 80 per cent mark opposite 1800 million, and so on.

The decrease is laid off below zero. Since 900 million is 10 per cent decrease from 1000 million, the minus 10 per cent mark is placed opposite the 900 million ruling, the 20 per cent opposite the 800 million ruling, and so on downward. The comparison of percentage changes may be made in this way between curves wherever they lie on the chart, because on a logarithmic scale equal distances indicate equal percentage changes. This is a



Source: Annual Report of American Telephone and Telegraph Company

FIG. 10 AMOUNT OF CHANGE CHART SHOWING GROWTH OF BELL SYSTEM



Source: Annual Report of American Telephone and Telegraph Company

FIG. 11 RATE OF CHANGE CHART SHOWING GROWTH OF BELL SYSTEM

particular advantage of the rate of change (logarithmic) chart which is not possessed by the amount of change or arithmetic chart.

When reading a chart drawn on a rate of change scale care must be exercised not to try to measure the amount of change with respect to the distance the points are above the base line. Fig. 11 is drawn with a wavy base line to indicate that the chart is cut off. There is really no base line on a logarithmic chart and no attempt should be made to refer the curves to a base.

If data which are to be charted increase at a very small percentage rate so that throughout the whole interval of time they do not approach a 100 per cent increase, it is not necessary to use a rate of change scale, but an ordinary arithmetic scale will be suffi-

ciently accurate on which to measure rates of change. The reason for this is that the geometrical or rate of change progression draws away very slowly from the arithmetical or amount of change progression when the percentage increase is small.

A system of charts has been devised for showing the difference between production and shipments, shipments and orders, and production and orders.[7] Fig. 12 is such a "divergence" chart, showing the divergence of production and shipments; when production exceeds shipments the amount of divergence is shown above zero, and vice versa; and directly below this is the divergence of production and new orders, with an excess of production over orders shown above zero and vice versa. The lower portion of the sheet, showing divergence between shipments and new orders, and stock and unfilled orders, has been cut away.

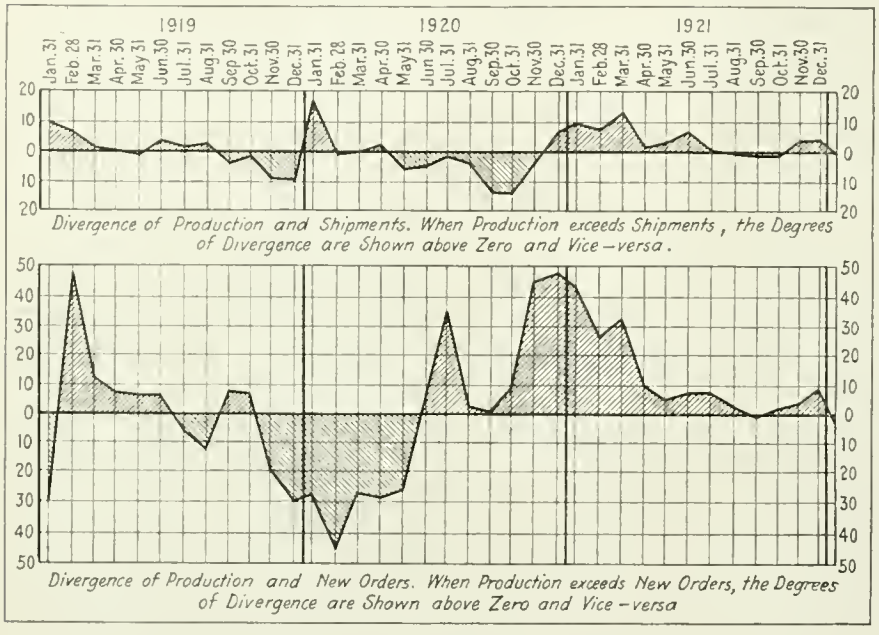

1919
1920
1921
Jan.31 Feb.28 Mar.31 Apr.30 May31 Jun.30 Jul.31 Aug.31 Sep.30 Oct.31 Nov.30 Dec.31 Jan.31 Feb.28 Mar.31 Apr.30 May31 Jun.30 Jul.31 Aug.31 Sep.30 Oct.31 Nov.30 Dec.31 Jan.31 Feb.28 Mar.31 Apr.30 May31 Jun.30 Jul.31 Aug.31 Sep.30 Oct.31 Nov.30 Dec.31
20 10 0 10 20
Divergence of Production and Shipments. When Production exceeds Shipments, the Degrees of Divergence are Shown above Zero and Vice-versa.
50 40 30 20 10 0 10 20 30 40 50
Divergence of Production and New Orders. When Production exceeds New Orders, the Degrees of Divergence are Shown above Zero and Vice-versa

FIG. 12 DIVERGENCE CHART OF PRODUCTION AND SHIPMENTS, AND PRODUCTION AND NEW ORDERS

Mr. Greenwood, who advocates this chart, has suggested that the area between zero and the curves above zero be colored purple, and the area between zero and the curves below zero be colored yellow for the top chart, and the corresponding areas on the lower chart be colored red and green respectively. The charts are arranged one above the other so that seasonal fluctuations may be compared throughout the series of years. In seasonal industries there are times when production must exceed orders and shipments in order to prepare for an anticipated demand, and later the production will fall far below orders and shipments because enough stock has been made to satisfy the orders. Divergence charts show these differences clearly.

A discussion of the construction of index numbers has been intentionally omitted from the present article because the compilation of such numbers has to date been restricted largely to special agencies which supply economic statistics for commercial and industrial purposes. Help may be derived from these statistics to guide intelligent purchasing and many financial operations. Valuable comparisons may be made between price movements of a company's principal raw materials and general market movements by plotting the prices of the raw materials, reduced to index numbers, on the same chart with the curve that is derived from the data which reflect market movements. The price of the raw materials at any time, or an average for any period of time, may be used as a base by which to divide all the other prices in order to reduce them to a series of index numbers. However, the same period of time must be used as a base for the calculation of the index numbers as has been selected by the compiler of the report to be compared.

If this base is not suitable it will be necessary to recast the index series obtained from the outside source. This may be done by dividing each number in the series by the number corresponding to the new point selected as a base. That is, the base number will be that number in the original series which represents the same point of time as the one chosen for the raw materials index numbers, or will be an average for this same period of time.

It is well known that times of prosperity and depression are anticipated by about six months on the stock exchange and prices of securities are therefore discounted this much in advance. There are many price movements which follow well defined cycles and bear some relation to other market movements with a quite constant time interval between corresponding points on their respective cycles. By charting the index of price movements for several years of one's raw materials, together with properly selected market indices, these time relationships may be brought out and the price trend of the material may be forecasted. Many other applications of a similar cyclical nature will suggest themselves, such as production and reported stocks of raw materials on the market, and production of goods in certain lines of industry related to each individual business.

The historical charts shown in this article have been drawn chiefly from the fields of sales and financial data. Their application in production is well recognized whenever a historical record is to be presented graphically. However, the majority of charts used in production are for measuring the progress of work, and for showing what is to be done from day to day in order that schedules may be met and promises fulfilled. For this an entirely different type of chart is used which will be discussed in the concluding article on the subject. This next article will also show an application of the use of frequency charts in analyzing sales statistics.

(To be concluded.)

[7] For a more complete description of divergence charts see *Management Engineering*, June 1922, p. 347, "Divergence Charts and Their Uses," and July 1922, p. 46, "Economic Application of Divergence Charts—A Discussion," by G. W. Greenwood.

Picking Out Your Bank

By HENRY PARKER WILLIS

Editor, Journal of Commerce, New York

Index Number
332.1 Banks
Financial companies

FOR a good many years past, bankers have had a way of referring to themselves as if they were the arbiters of business and industry. Writers on finance and banking have fallen into the practice of referring to bankers in this same magisterial way. Banks are, by them, often spoken of as "granting credit," or as "extending accommodation," or "affording assistance," to industry. As a matter of fact, these expressions date from the period of the British "bank parlour" presided over by a solemn functionary to whom access could be gained only by the elect. Modern business conditions have changed this situation, and today it is good practice for the active officers of a bank to be seated in full view of the customers, while it is recognized that they are engaged in the business of selling the bank's services and that they are as eager to increase custom and get new business as the trader and manufacturer himself.

A Change of View

Of course this implies a great change of view. "The ownership of a bank account," said Adam Smith, "was once the badge of a considerable business;" and he might have added that the difficulty of establishing it was somewhat analogous to that of obtaining membership in some jealously exclusive organization. The bank still likes to regard itself as "selecting" its affiliations very carefully, and this fiction has been kept up by the practice of requiring references from would-be customers. As a matter of fact, the wise business man today selects his bank quite as truly as his bank selects him; and he makes his choice in the same way that he does with his other connections. While he may not ask the bank for "references," he accomplishes the same purpose through investigation of its capacities and methods and in other similar ways. Still it remains true that the rank and file of the smaller business men of the country are inclined to look with extreme deference upon the banker, and to fail to recognize that there is quite as much reason why they should employ methods of discrimination in their choice of a bank as there is that the bank should be very select and careful in its admission of customers of the types it prefers.

It is certainly conducive to success in business that the trader and his bank shall be well matched, and this harmony implies the use of certain very distinct canons of selection on the part of the former. If one were to state them briefly, he might classify them as those of size, location, scope, service, and expertness. The first is the most obvious. In foreign countries, especially those of English antecedents, as in Great Britain itself, it is rather "bad form" for a customer to keep more than one bank account (or, at most, two), especially if he be a regular borrower. This limitation is an outgrowth of the older thought that the business man needs to be subjected to very careful supervision on the part of his banker. The idea of such supervision was feasible only so long, however, as the banker was very much stronger and more capable than his customer. In the United States, the growth of independent banking and the establishment of some 30,000 institutions, large and small, has brought it about that the business man must, first of all, make sure that his bank is large and strong enough to "take care" of him. The National Bank Act limits the maximum amount of loans to be made to any one customer to 10 per cent of the bank's capital and surplus, and even when all possible devices of acceptance financing and others have been resorted to, the limitations of law and regulations still hold the possible scope of accommodation down to not over 35 per cent of capital and surplus.[1] Nothing is more uncomfortable and unfortunate than to find that a bank which has carefully investigated a man's credit and would gladly accommodate him cannot do so and yet keep within the limits of the law. The business man ought therefore, first of all, to make sure that his bank is large enough to provide for his needs in all probable contingencies; or, to put this practically, if his business shows that he is likely at times

[1] Of late years amendments to the act have somewhat broadened the amount of indirect accommodation that can be obtained at national banks, but the limits upon direct borrowing (the type most common in the United States) remain. State laws have tended to assimilate themselves to national practice. Because of the general misunderstanding of the exact limitations of present law the following illustration of combinations of types of borrowing possible under existing law is furnished:

	Illustration 1 Per Cent	Illustration 2 Per Cent	Illustration 3 Per Cent
Accommodation or straight loans	10	5	5
Notes secured by warehouse receipts, etc.	15	20	15
Notes secured by a like face amount of government obligations	10	10	15
Total	35	35	35
Bills of exchange drawn against actually existing values	No limit imposed by law.		
Commercial or business paper	No limit imposed by law.		
Notes secured by at least 105% of U. S. Government obligations	No limit imposed by law.		

to want loans up to a certain figure, he should make sure that his banker is legally authorized to grant such loans—that is to say that his capital and surplus is large enough to permit it. It may be that some very large concerns cannot find banks that are able to handle their whole borrowing, but these concerns are usually organized with branches and hence can divide their credit needs, and can compare their local borrowing with the accommodating power of the banks in those places. Briefly stated, no concern should become dependent upon a bank whose capital and surplus are not at least ten times the maximum direct borrowing that the concern is likely to need to do at any one time.

Location of Bank

The location of the bank with respect to the business which depends on it is considerably more important than is generally understood. In the larger cities the mere question of conserving working time is important. The business man himself may not care to go to the bank, either to deposit or to withdraw funds, or may go there only occasionally, transacting his actual day-to-day business through subordinates. The time of the subordinates, however, is valuable; while the increasing hazards of loss, through theft, robbery, and in other similar ways, have tended of late to emphasize the undesirability of compelling employees to make a long trip to the bank. In general the bank's office at which the business house expects to carry on its transactions should not be more than a few minutes distant on foot or by public conveyance from the establishment itself, except under special conditions. This is a requirement which probably could not be strictly complied with, were it not for the rapid expansion of branch banking which in many countries has placed an office easily within the reach of almost any section of the larger cities. Branch banking has been retarded in the United States; but it is beginning to develop on a scale somewhat comparable to that of the Canadian and British banks, so far as conditions in the cities are concerned. In many places we have made up for the lack of branches by special methods of collecting deposits and delivering pay-rolls, and these expedients have in some measure tended to enable the business man to extend the choice of his bank outside of his own immediate area and to that extent have modified the general requirement of location just indicated. Banking by mail has been successfully developed and enables the concern whose receipts are chiefly in checks and which disburses its funds largely by check also, to employ the services of a bank at some distance. Speaking generally, however, the business man needs his bank or a branch of it close at hand, both on account of the saving of time and the avoidance of loss which are attained by such proximity.

While these considerations are the directly controlling ones in a majority of ordinary business undertakings where the operation is merely that of retailing goods or perhaps of simple manufacturing for local consumption, the problem of choosing a bank becomes a good deal more difficult as the complexity of the business increases. For example, a business establishment which is carrying on transactions that involve foreign connections or the financing of export trade, requires the services of a bank which is qualified to assist in this particular kind of undertaking. Take the export manufacturing concern, for example. It needs to have access to credit files and to be placed in position to offer for discount good foreign paper growing out of its sales if it is to meet with any success in transacting its distant business. This means that the bank it chooses must have a highly organized foreign credit department, as well as a completely equipped foreign exchange department, or the two in combination. Thus provided the business man is able to come to an understanding with the bank for the handling of his collections, the supplying of his remittances, the discounting of his drafts when required, and in general the performance of all of the functions of banking which are needed in the management of export trade. In a similar way, the domestic business man who is carrying on, let us say, a large grain or cotton buying business, finds it expedient to deal with a bank which has specialized in and understands the paper that grows out of these particular types of industry, so that he will have no difficulty in financing himself. Such banks also need to have abundance of good connections in the grain and cotton districts in order that they may readily transfer funds thither as well as obtain the services of which they stand in need from correspondents. Much the same holds true of other specialized phases of banking business; or to put this in another way, most specialized lines of trade should be associated with banks that have specialized in those same lines and are familiar with their peculiar problems, in order that they may get the full accommodation to which they are entitled.

Specialized Banks

For it is a fact that specialization in banking has been carried to a fairly high point and is daily going further in that direction. Foreign trade banking has not expanded as rapidly in this country as it has elsewhere; and yet today it is very much more advanced than it was 10 years ago. Among the city banks, long ago there began to be a distinct segregation between those that were most interested in collateral loans and those which concerned themselves chiefly with commercial advances. Even among banks which specialize in collateral loans, there are today further subdivisions, some banks making a particular effort to accommodate customers who are in possession of certain kinds of collateral. Among the commercial banks, there has been an increasing tendency to divide the business of the different trades, some banks gradually taking to themselves the bulk of the textile business in given cities, while others are predominantly manufacturers' banks and still others find the bulk of their commercial demand in the retail trades, the clothing and dry-goods lines, and others. The packing house industry has developed its own banks with a high degree of success and the automobile industry is beginning to do likewise. There is a great deal to be said for the choice by a business man of a bank which is expertly specializing in the paper of his own industry. It is true that some still contend that they would much prefer

to be the sole customers of a bank in a given field than to share its attentions, within that field, between themselves and a variety of other establishments transacting the same kind of business. General opinion, however, moves in the opposite direction and is on the side of the view already expressed.

The Service Function

The service function of the bank is a phase of its relation to the customer which, on the whole, occupies a rather less important place than do the considerations relating to scope. It, nevertheless, is of very large importance to some business men. Not a few individuals want to be able to get any kind of attention from their bank that they may desire, for the same reason that they prefer to go to a department store rather than to visit a number of specialty shops. The business man frequently needs or likes to have provision for such functions as the purchase of bonds and stocks, so that he can place his order direct for buying or selling without going to a broker; or he desires to have the bank provide safety deposit vaults in which his holdings can be carefully stored. With the advance in the art of vault-making and arrangement, it has been found the part of wisdom to keep securities and even books in a neighboring safety deposit vault rather than in the concern's own safe. In such cases, as a rule, the business man prefers to use vaults which are under the control of his own bank. Among the service functions that are increasingly popular are those which relate to the actual physical care of bonds and other securities, the clipping and collection of coupons, the preparation of income tax statements and the like. Fiscal functions pertaining to the business are increasingly transferred to the bank. Other things being equal, therefore, the business man will prefer a bank which is completely and carefully organized, even though on a limited scale, with provision for all functions permitted by law even though modern practice thus includes a number of service functions which are not exactly banking. These are a good deal more important to some business men than to others; and the choice of a bank should be only secondarily conditioned by them, although, as already remarked, they afford an element which ought not to be neglected in picking out the institution with which the business wishes to see its transactions carried on, if work of the sort referred to is likely to be needed by the concern.

There is one consideration tending to influence the business man's selection of his bank that, however, oftentimes overtops all others, in special cases. This is found in connection with the furnishing of careful expert advice concerning the financing of the business. There are many enterprises of the present day whose financial problems are anything but solved, since they do not comply with the older methods of credit solution. The management is developing a new kind of product or opening up a new market; it is taking on a new sort of credit risk, or developing selling methods which require a new attitude toward maturities of paper or of "open accounts". Such cases call for a high degree of ingenuity and expertness in devising new means of appealing to the owner of capital or of placing commercial obligations under conditions that will keep interest rates down and nevertheless insure a ready sale for the paper. The increasing specialization of industry and the high development of division of labor have brought about a condition also, such that the business man or corporation is often able to save expense by developing new types of financing, or to extend his business by the use of ingenious and especially appropriate methods which are off the beaten path. There is a strong tendency in some banks to refuse all financing which does not permit the application of very conservative and well-established rules of one sort or another, with a view to laying a thoroughly orthodox and impeccable foundation for credit. If this attitude should be strictly adhered to, in every case, the result would be to deprive various new businesses of access to credit.

A New Credit Problem

For example, take the rapidly changing moving-picture industry. At present, the producer of a moving-picture spends a great deal of money in developing a film which is to be shown to the public at a specified time. It frequently happens that his available capital becomes entirely "tied up" in a number of films, so that he is obliged to go to the bank for accommodation, or else wait until he can get income out of the exhibitors. This means that if the bank extends credit to him, its security is likely to be the film itself, which means in fact the contracts that have been made for exhibiting it. Hence the bank has to assure itself that the picture is likely to be popular enough to pay back the loans. This is a new kind of credit problem for the bank, and involves not only the application of a specialized type of judgment as to the worth of the film itself, but also the development of satisfactory documents covering the transfer of the rights to the receipts of the theaters at which the production is to take place, or a fraction thereof, over a sufficient period to reimburse the lender. If the bank does not take a large enough percentage of receipts, it may find itself at the end of the season with a claim to some old films which have lost their popularity. Still more difficult is the question of loans upon "used films" which are to be run a second or third time, with the corresponding uncertainty as to how the public will regard them. A very similar problem presents itself in connection with the financing of a business now understood to rank, in the value of its products, sixth or seventh among national industries—the automobile trade. Producers of automobiles, and observers of the growth of that business, have for some time past feared or predicted that the so-called "saturation point" of public demand would shortly be reached. By this they have meant that a time would come at which the buying power of the public would not be adequate to take off the hands of manufacturers the quantity of machines which they are continuing to make. Thus far, the arrival of such a point has been deferred, largely as a result of the adoption of new methods of financing the purchase of machines by buyers who were not in position to pay for them either in a lump sum or over a very short credit period. The result has

been to develop special methods of short-term financing, protected by titles to the individual machine, with series of notes maturing about in proportion as the automobile loses its value in the normal course of actual use. As a result of these methods of financing, it has been possible for the automobile trade to develop much more broadly than it otherwise could, while the smaller makers of automobiles, who were not themselves in position to extend credit on any great scale, have been enabled to compete successfully with concerns that were more fully capitalized.

Finance Companies

In the process of developing new kinds of industry the bank can be of large service along lines just indicated. How far such service is desirable from a social standpoint, or at what point the bank, by its ingenious methods of tapping credit draws too heavily upon the social fund of wealth, is a broad economic question which we need not discuss here. Under the competitive system, the business man is concerned primarily or solely with the legitimate development and exploitation of the market for his own particular product. In the course of assisting him to accomplish these objects, the bank frequently finds that a kind, or duration, or quality, of credit is called for which it is not in position to supply with its older machinery or indeed with any that it cares to develop. It may, therefore, think fit to direct its customer to some auxiliary concern which is in position to help him by the application of special financing methods. One of the best examples of these enterprises is furnished by what are known as finance companies. There has been a great reluctance on the part of the more conservative banks to join hands with such companies, even when that course of action appeared to be called for by the necessities of the borrower and the requirements of wise management on the part of the bank itself. Not a few banks and credit men have regarded them as means for getting an undue allowance of credit in behalf of business which they themselves did not consider especially entitled to such accommodation. This is another large question which must eventually be settled on broad grounds. The point which is now made is that many of the more up-to-date banks which have been inclined to study their customers' wants very closely, have in numerous cases of recent years found it desirable to effect a working arrangement with a concern organized for the purpose of helping the customer to obtain access to fields of capital and credit which they themselves were not in position to touch. Under the best conditions, the bank allows its customer his proper line of bank accommodation duly secured, and then directs him with its full knowledge and approval to the supplementary institutions which are qualified to take care of his additional credit needs. These may be finance companies as in the case of the wholesale dealer in furniture, automobiles, and supplies of various kinds that are sold on long terms; or they may be acceptance houses (discount companies) as in the case of some branches of foreign trade, or in more familiar fields they may be private bankers and bond institutions through whom more working capital can be obtained by the issue of long-term obligations. In any of these cases, the bank may render a very desirable and most valuable service to the borrower by diagnosing his business needs.

Wise and successful business management is seldom purely selfish. The manufacturer with vision, therefore, usually finds that in selecting his bank, and in applying the canons of choice already laid down he needs to keep constantly in mind the requirements of the local community where he is situated. This is not because he feels any need to be a philanthropist or public benefactor, but simply because his business necessarily depends upon the prosperity of those about it. The working of this principle is seen in connection with the question of using local banks, whether in city communities or in the country. The business concern that depends upon the public must do what it can to aid in making the public good buyers; it must, in other words, leave no small part of its funds at those points where they originate unless it wants to see the surrounding area starved for want of bank credit. The theater or moving-picture house or restaurant or shop wants to find itself more and more the center of an active business community with the resulting demand and prosperous trade. It will, therefore, act wisely if it takes pains so far as it can to deposit its receipts in some bank not too far from the establishment, and sustaining direct relations with other business houses and borrowers in the immediate vicinity. It thus tends to insure the continued use of the community's funds to nourish local enterprise instead of diverting them elsewhere. In this way, it tends to build up its own future business, since its success is necessarily dependent wholly upon the prosperity of its customers. This consideration is quite as cogent where the business has branches over a considerable area and may leave its funds for local use or tranfer them elsewhere. The latter policy tends to limit the capital resources of the community or locality and is correspondingly undesirable. In brief, the business in making its banking connections will safeguard its own future best by leaving its receipts as nearly as possible in the general group from which they were originally drawn. This is a principle that cannot be rigidly pursued by all businesses but which is in not a few of them—especially those that appeal to a concentrated group of customers—almost essential.

Local and Trade Competition

In this connection, too, there recurs the question whether the commercial or manufacturing company must not take particular pains to guard itself against some forms of illegitimate competition that may attack it through its choice of a banking connection. There is unquestionably a danger of that sort which ought to be frankly faced. The business house, especially if it be a large and regular borrower, does not want to be dependent upon a bank whose directorate includes active or dangerous competitors. It is not desirable that the latter should know either the credit policy or the current position of the house at any given time and it is often felt, therefore, that the presence of such directors forbids the choice of a bank which in

every other way conforms to the standards of selection that have been enumerated. There is an undoubted tendency on the part of many banks to attract to their boards outstanding figures in the commercial and industrial world because of the valuable business that such directors are able to bring with them. The system has, however, the defects of its qualities because the incidental effect is to frighten away the business of the competitors who have just been mentioned. The objection of the latter to being overlooked by rivals is well-founded, and while it may be overcome in certain cases through the giving of definite assurance in various ways that directors who are thus viewed with hesitation will not be suffered to possess information that ought not to come to them, it will always more or less prevent business houses from affiliating themselves with banks that in every other way are eligible. The bank must not be a channel through which competitors may either improperly inform themselves or place obstacles in the way of others.

As a result of the steady development of the general principles and ideas which have been sketched, a much more harmonious and uniform development of American banking is being gradually introduced. Institutions are more and more closely adapting themselves to customers' needs and the latter are more and more wisely distributing themselves among the banks. The day of the brass-bound bank with its rather extravagant and tawdry display of marble and fixtures, its hail-fellow-well-met vice-president and its large entertainment fund for customers is passing. Modern banks sell service and must provide the kind and quality the customer requires. The latter acts wisely if he is not carried off his feet by size or flattery or laxity in credit at the outset. He has a need for wise and sound financial advice, economical extension of borrowing facilities and specialized treatment of his needs. In some cases, one of these will prove the controlling or directing factor that should determine choice, in others a second or third will be decisive. All will have some weight in every case where a selection is carefully made. The best adaptation of facilities to requirements produces satisfied and successful bank customers and reacts directly upon the progress and growth of the bank itself. It is the highest type of "new business" development.

Why Not Censor Industrial Ventures?

By E. H. FISH

BUSINESS is changing. We are developing into cliques, each hoping to prey on the great general public. Of course we do not mean to prey, literally, but that is what the great purchasing public call it.

We are also getting together. I presume there is a National Association of Rag Doll Manufacturers, though I do not know its secretary. There are associations of workers, manufacturers, sellers and every other organizable kind of persons. Each body is trying to form a defensive and offensive organization.

In all this we are forgetting the great public. Someone called it the "Great unwashed," but in these days of mail order bath tubs and correspondence school plumbers that is hardly correct. What we overlook is that this great public, now washed, is really organized even if its members do not know it. The organization is known as the United States. It numbers upward of a hundred million members, of which about a third are or can be active voting members. It is powerful enough to crush every little trade, professional, agricultural or any other kind of an organization, if the members awaken.

The Public's Force

Some people are afraid of the manifestation of this organization. We say that they are afraid of publicity, of public opinion. It is a great force, but does not appear unless there is a great emergency. Even then it is extended over trivial things as well as great. Just before the war public opinion had brought the use of cigarettes down to college students and a few others. It had pretty much wiped out prize fighting. The war brought both back and established them in high social standing.

Index Number
338 Supply and demand

Will the time come when public opinion will crystallize on some one abuse and wipe it out? Will it center on the coal situation and force either or both sides to confess and promise to be good? Will it center on the shoe trade and compel manufacturers to give up fancy gewgaws and make good, sensible, wearable shoes once more? Will it come down on the rag doll business and compel manufacturers to put prices where children can have doll babies without appealing to a fairy godmother for financial aid?

None of these things seem likely at the moment, and yet any one of them may happen whenever something occurs that focuses public attention on it. So long as the coal situation remains a local one, New England will have to pay luxury prices for anthracite. If, or whenever, the whole coal industry is tied up there will be enough pressure of public opinion to untie it, but if the pressure is only sectional nothing happens. The section must learn to buy lower priced goods and use them until the cost of the luxury comes down. The shoe pinches only those few who want sensible footwear; so long as the majority want only show they may cultivate corns at their leisure. Rag doll prices can be doubled and tripled without much lessening of purchases.

The one center, however, for all these sectional complaints, the class difficulties, is in Congress. If I am particularly struck by the high prices of rag dolls, I cannot expect to make much headway alone. I can only get a reputation for being a chronic grouch. But if I can combine with some one who does not like the

shoe situation and another who is short of hard coal, we can get our congressmen interested in an equalization of prices and possibly we may, in years to come get some relief.

A Censor for New Corporations

What we are suffering from right now is the lack of a censor for new corporations. If we were cast away on an island, *à la* Robinson Crusoe, with a shipload of seed potatoes, we might be ignorant of farming and plant so many spuds that when we dug the crop there would be many times as much as we could eat before the next crop. One year's experience would give us a pretty good idea of what was sensible. We would not want to waste the labor to make a bigger crop than we could use. The same practical viewpoint would hold with everything else we raised. Let there be half a dozen families and each would probably raise its own crops, but if there were a hundred families the man who had the best luck, or scientific knowledge of the potato game, would raise all the potatoes, another would raise all the wheat and so on. Each year it would be easy for these farmers to count the new arrivals and the funerals and arrive at the proper acreage.

But the moment we get two farmers raising potatoes only, then the trouble begins because each may be ambitious, and may want to raise, and sell, the entire crop for the community. The moment there is an oversupply there is a choice of two evils, one to store the potatoes and try to unload them the next year by raising a short crop, the other to throw them away.

In practice nowadays, producers get together, store the crop, and shorten production on that particular item. Perhaps they put in a larger acreage of corn and take out a license to make the surplus into alcohol which will keep without deterioration. When they do this, however, they are legislating for the community, and that is where the one big union, the United States, comes in, or should come in, to say what is the necessary acreage to be planted, allowing for drought, flood, and other uncontrolled items, so that every one will be fed and no unnecessary waste of labor shall happen. After the community has grown beyond the first hundreds no one can say for himself alone that there should be just so many acres of potatoes in the entire world and that his just proportion should be three and one-eighth acres.

What Happens Without a Censor

This same thing applies even more to the product of our shops. It is pretty well known how many 10 hp. motors of a given type are used year by year. The trouble is, who should build what percentage of that number. I may have been working for one of the big electric companies. I may find myself on the outside some morning, and may rush madly about hiring a shop, enlisting capital and making designs for a superior motor with a shaft a sixteenth of an inch larger in diameter and a quarter of an inch longer than any other make in the entire world. There is no one to say me nay. The National Association of Builders of 10 hp. Motors may find out about my activities *after* I have the capital all invested, and they may suggest that I change over to an 11 hp. size, or something of that kind, because the field that I am stepping into is overcrowded. But they are too late, cannot have any authority, and their aim is frankly selfish. At that stage of my development, of course, it is to be expected that I know a great deal about motors and am very much impressed with the idea that they fear competition and want to scare me away.

What I need, and what the business needs, is for someone with authority to tell me that the supply was so-and-so last year, the sales so-and-so, and how can I expect to get a foothold on a market that will not buy the output of people who have million-dollar sales organizations, and ask me why do I not make something that was underproduced last year.

Of course, a government agent who acted in this very paternal capacity would need an unlimited supply of experts who could spread before me, *before I began my organization,* the facts of the industry as a whole and let me know what my chances of success were. To reach me before I began operations, he would have to have so completely inspired the mechanical world with his fairness and ability that I would consult him. Such a function cannot be filled by a private concern.

Who Need Advice Most

Most of the advice should be given to persons who have not the money to pay the cost of collecting the data on which to base the advice. If I am starting in business for myself the chances are I have had to pawn my wife's earrings to get the money for the last lot of things that I did not realize I would have to have. I am in no position to pay anyone to tell me that I am starting in a field in which I have not a Chinaman's chance. My prospective competitors can afford to give me the data and the advice but that is transparently biased and I am not to be blamed if I suspect that their counsel is tinged with selfishness.

While I might be prevented from going into a business venture by adverse advice in regard to the prospects in the field, still I need other advice which a censor might give me, in at least comparative form. For instance, what should be my production results, the effect on my financial management, my sales results, and the influence of economic cycles? A counselor who really understood the basic factors in the field which I am thinking about would be able to give me ratios or percentages to show what I ought to do in order to build a sound business. It is very possible that with these facts in front of me I would modify my original plans even though I did not back out of the venture, and so construct with less prospect of disaster.

Counsel of this kind must be real management information. Many of the basic facts are already collected by departments and bureaus of the government and by certain private agencies. For instance, high in the list of causes of business failures, ranks lack of knowledge of markets and lack of proper financing. Surely the possible usefulness of the censor of new industrial organizations is greater than that of most business callings.

Industrial Coal-Handling Equipment

Types, Capacities, and Adaptability of Various Installations

BY GEORGE E. TITCOMB

Eastern Branch Sales Manager, The McMyler Interstate Company

Index Number
658.281 Mechanical handling
621.86:662.65 Coal-handling equipment

THERE are many different types of coal-handling apparatus used in transporting, storing, and reclaiming fuel. Some of these are specially adapted for railroad work, for coaling freight, passenger and naval vessels, for use by wholesalers at waterfront terminals, and for large-scale retailers in local yards. Such types will be omitted in the discussion to follow, which is concerned directly with equipment applicable to the individual industrial plant.

One of the simplest forms of apparatus, aside from the kind which requires one or more hand laborers as shovelers to feed or remove the coal, is the crawler tread locomotive crane, the 10-ton size being shown in Fig. 1.[1] The crane illustrated here is equipped with a 1 cu. yd. bucket at the end of a 40 ft. boom, and can travel anywhere within the storage area because it is independent of tracks. With this type of crane, unloading can be done at the rate of 40 tons or more per hr., and reloading to trucks or receiving hoppers is accomplished at the same speed. Coal can be piled to a height of 25 ft. The cost as compared with hand shoveling includes wages of crane operator and in some cases one or two helpers, fuel, repairs, maintenance, depreciation, interest on investment, superintendence, and the overhead charges of a more indirect nature incident to mechanical equipment. Hand labor, on the contrary, involves more expense in direct wages alone per ton of coal handling than the total of crane costs, and the heavy overhead connected with hand labor, almost always an unknown and neglected factor in comparative calculations, probably doubles the actual hand-labor expense.

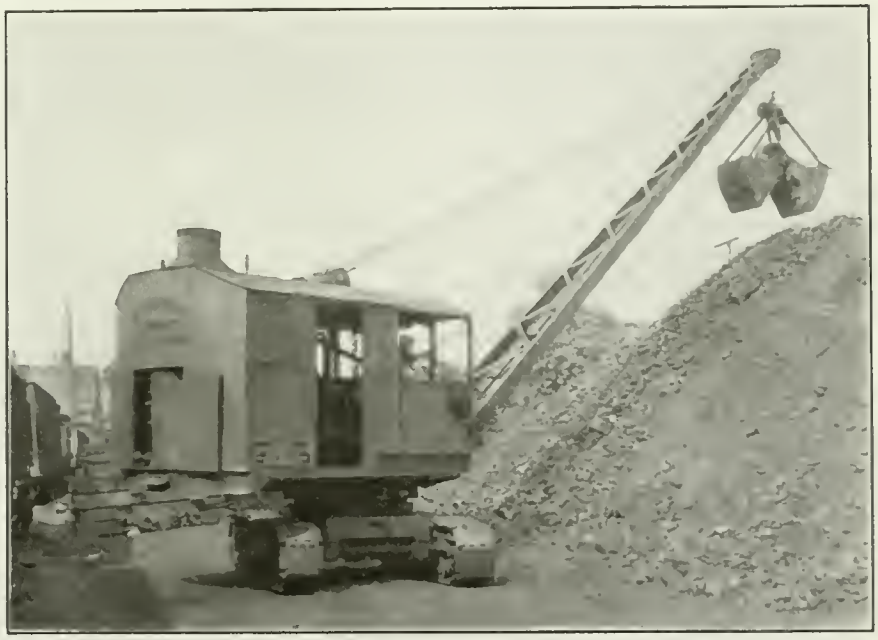


FIG. 1 THE CRAWLER TREAD COAL-HANDLING CRANE

Fig. 2 illustrates a type of locomotive crane employed where railroad tracks can be run between points of delivery, storage, and use of coal. The equipment is standard gage, and the crane moves coal cars from siding to storage and from storage to point of consumption, and handles the fuel off and on the cars.

The 20-ton crane in Fig. 2 is used at the Camden Coke Company. It has a boom 50 ft. long and operates a bucket of 1½ cu. yd. capacity. A special feature of this crane is its ability to pile coal to a height of 35 feet, and to reach the top of hoppers at close range, accomplished by providing a bend or gooseneck in the boom a little beyond its middle point.

Cost of handling is lower with this crane than with the crawler tread crane in Fig. 1 because the capacity is greater while the overhead charges are not much increased. From 60 to 100 tons per hr. can be handled with the crane shown in Fig. 2.

The method of reloading coal from storage pile to truck is illustrated in Fig. 3. In this case the crane used is of the standard gage type, 23 tons capacity, and using a 1½ cu. yd. bucket on a boom of 50 ft. radius. Coal can be piled to a height of 35 ft. While the size of this equipment makes it possible to handle from 60 to 100 tons of coal per hr. this rate is not attainable as an operating schedule where trucks are used, on account of their limited capacity and the interference of the vehicles with each other. Where reloading is done on cars, however, the full rate of handling is possible.

Where larger quantities of coal are to be stored and where the storage areas are of considerable extent a crane of greater capacity is required. Fig. 4 shows a broad-gage crane running on four tracks. These cranes are commonly made for a rail spread of 16 to 24 ft.

[1] The capacity of a locomotive crane is rated by agreement among crane manufacturers at the load it will lift on a 12 ft. radius. Thus, a 10-ton crane is one which will handle a 10-ton load with the boom raised so that the load center is just 12 ft. from the pivot on which the crane body swings.

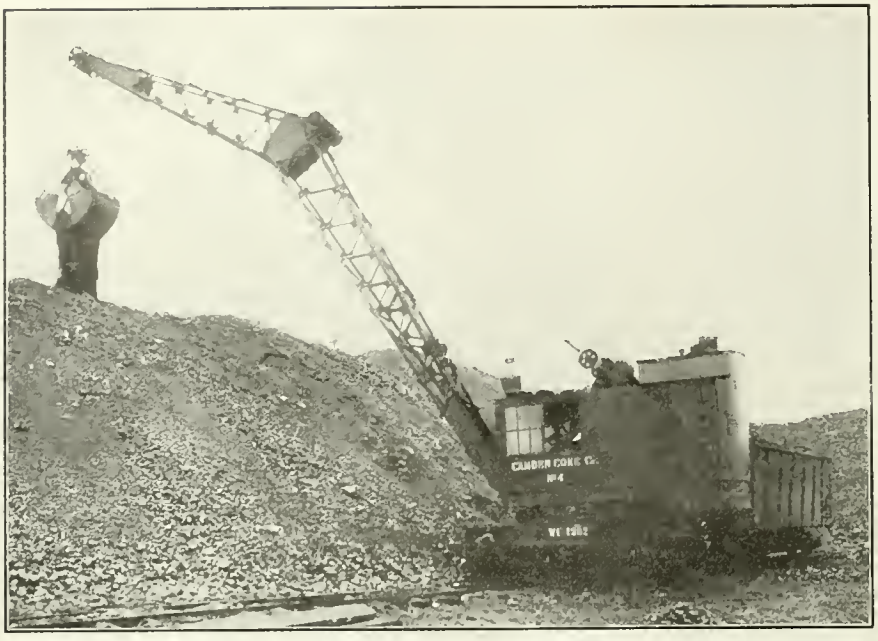


FIG. 2 STANDARD-GAGE CRANE WITH GOOSENECK BOOM

The purpose of spreading the base in this fashion is, of course, to provide counterbalance for the boom and bucket. The boom is 100 ft. long. It carries a clam-shell bucket of 5½ cu. yd. capacity and will handle 200 tons of coal per hr. Due to the long reach two methods of storing are possible, one in circular piles and one in rectangular piles, the possible height being 55 ft. Anthracite coal may be stored at this height but bituminous coal should not be stored higher than 40 ft. on account of the danger of spontaneous combustion. The ability of the crane to reach a height of 55 ft. makes it suitable for use at close range to dump into high overhead hoppers.

A closer view of a rope-reeved clam-shell bucket is given in Fig. 5.

This particular bucket is of 11 cu. yd. (300 cu. ft.) capacity, and is used, of course, only in very large plants, where it can be mounted on a traveling bridge. A common range of sizes runs from 3 to 5 cu. yd. Buckets of this type will handle anthracite and bituminous coal in any form, in fact, any loose, lumpy, or fine material. They are frequently applied to ore and limestone handling. (See also Fig. 10.)

Large industrial plants are often situated on a waterfront where raw materials and fuel can be received in boats or barges and freight and handling charges on vast quantities of supplies are considerably reduced. The Victor Talking Machine Company, located on the Delaware River at Camden, New Jersey, is one example of a plant so situated. To supply fuel to the power plant, which is at the water's edge, a large coal storage pier has been built to receive shipments by barge. A view of this pier as it looked during the later stages of its erection is shown in Fig. 6. Concrete end, side, and partition walls retain the coal and enable it to be piled to a considerable height. Through the middle extends a concrete trestle on which are mounted rails to carry the inner legs of two large bridge tramways or unloading bridges. The outer legs run on similar rails on the outside retaining walls.

A view of the completed coal-handling system at the Victor plant is shown in Fig. 7. The traveling bridges carry an overhang which extends out above the coal pockets in the barges. Coal is raised by means of a bucket, run in along the bridge and back to the desired point of dumping, and piled as high as the tramway clearance and angle of repose of the fuel will allow. The rate of handling for each crane is 100 tons per hr. Under each crane a total of from 15,000 to 25,000 tons of coal can be stored.

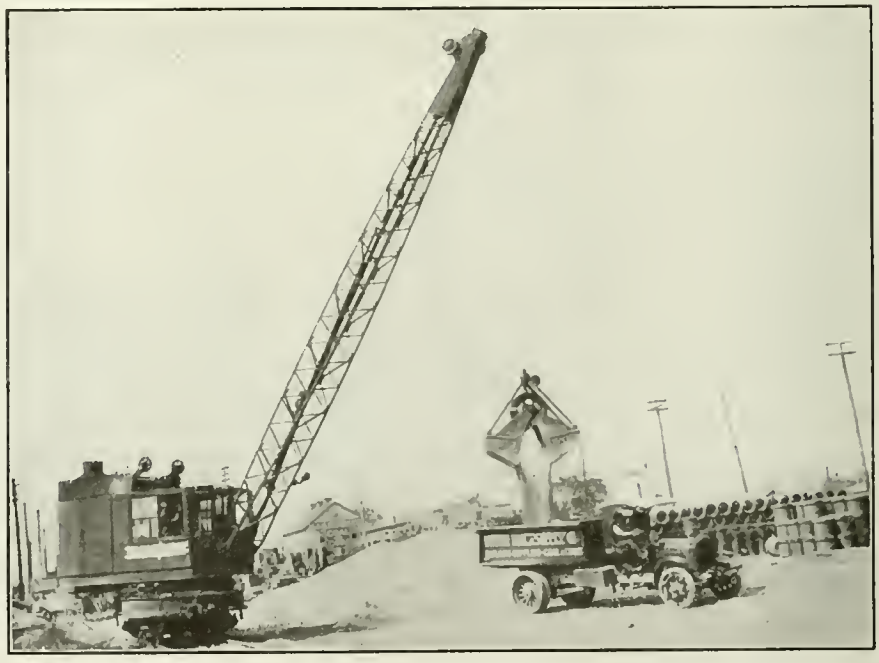


FIG. 3 LOADING COAL FROM STORAGE INTO TRUCKS

A special feature of the installation is the fact that the pier floor has been built at a level with low tide. The side walls are water-tight and considerably higher than high tide level. At Philadelphia the range of tides is about 6 ft. In the side walls are flood valves so that in case spontaneous combustion causes a fire the bottom of the coal piles can be submerged to extinguish the fire. If necessary, water can be pumped into the storage space to the height of the retaining walls.

Another kind of crane developed for waterfront delivery of coal is shown in Fig. 8. This crane, (two are

FIG. 4 BROAD-GAGE TYPE OF COAL-HANDLING CRANE WITH 100 FT. BOOM

operating in the picture), is known as the traveling or unloading tower type. It has a hoist which extends out over the barge or vessel and carries the unloading bucket. The bucket in the picture has a capacity of 1½ cu. yd. and enables the crane to handle 200 tons of coal per hr.

In the case illustrated the coal is dumped into receiving bins mounted on the crane. Cars are run underneath these bins and are filled by discharge hoppers spaced at track intervals. From this point the cars then may be taken either to the storage yard or the boiler-house where they are unloaded by bottom dumping on a trestle or into a hopper, by locomotive crane, or by overhead traveling bridge, according to the equipment in any particular plant.

FIG. 5 AN 11 CU. YD. CLAM-SHELL BUCKET

The installation of the receiving bins as a storage medium between boat and cars is an economy. Those in the picture hold about two carloads of coal. If the crane dumped directly into cars, additional travel would be necessary with each bucket load, increasing as successive cars were filled. As the buckets operate very fast, a needless loss of time would result from moving the cranes with each hoisting operation. Crane movement, of course, could be saved by having an engine attached to the train of cars to pull an empty underneath as soon as the preceding car was filled. The cost of operating a locomotive, and the impossibility of having enough length of track for this method on the average pier running out into the water, eliminates the scheme from consideration, and leaves only the overhead temporary storage bin plan available.

As will be noted from the photograph the crane and its receiving bin are mounted on structural steel framework, and the whole device runs on tracks so that it can move to any position necessary to give access to the hold of a vessel. The runways for the hoist can be raised up so that they will clear the masts of a boat when the crane or boat is moved. The operating position is the one shown in the photograph.

At first glance it may appear that the clearance between cars and crane is excessive. However, gondola cars are higher than those shown in the figure, and, in addition, the wharf in many plants will be utilized for loading or unloading freight in box cars, so that the height of the crane must be sufficient to clear such rolling stock when it has to be run beneath the crane to gain access to a vessel. The clearance must also be allowed in order to avoid collisions with the stacks of yard locomotives.

In some very large plants it is necessary to handle coal in great quantities and an extensive system is required. Where these plants are located on railways instead of waterfronts all the coal is received in cars. Unloading by any of the devices previously described is too slow and by comparison too costly. If trestles

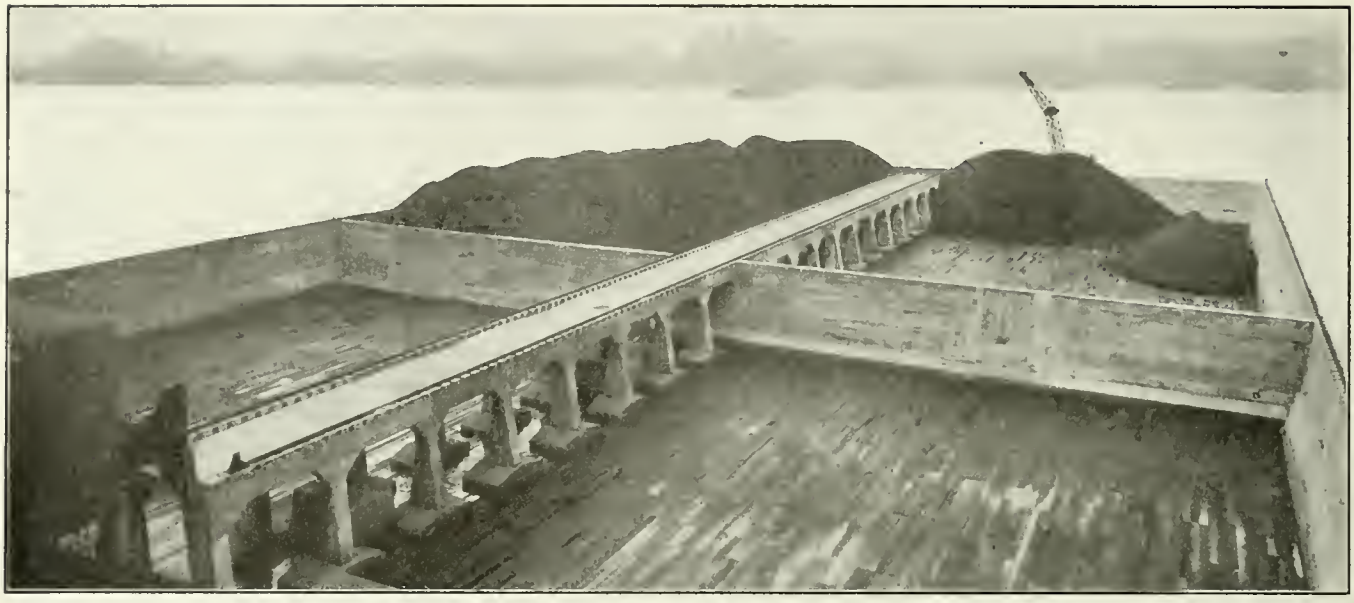


FIG. 6 VIEW OF COAL STORAGE PIER WHEN UNDER CONSTRUCTION AT THE VICTOR TALKING MACHINE COMPANY PLANT

are available at storage points bottom dumping can be employed. But the ordinary car has no dumping facilities, and even when bottom dump hopper cars are received considerable time and labor is necessary to empty them.

The system illustrated in Fig. 9 will overcome all of these objections. Railroad cars are run on a large roll-over framework and then raised and turned over, being automatically clamped during the inversion, and discharging all of their contents at once onto a broad chute forming one side of the tilting mechanism. Guides at the end and middle turn the coal into suitable channels of flow and the whole mass falls into a large, specially designed, transfer car for removal to the storage point. If however, the fuel is for immediate consumption, it is dumped from the cars directly into a receiving hopper underneath where the transfer car stands in the pic-

ture, and is carried by belt-conveyor to the boiler-room.

The difficulty of distribution at the storage point is overcome by the special feature used for dumping. A series of discharge doors, covering almost the entire length along each side of the car, and opening toward each side of the track, chute the coal well out, and it is then handled by traveling bridge to the storage pile, as shown in Fig. 10.

Car dumpers empty a car of from 50 to 100 tons every 6 min., which is sufficiently rapid to keep up operations steadily. Where car dumping is used to load barges and vessels the rate of handling approaches one car per minute. At the Baltimore & Ohio coal pier, Curtis Bay, Baltimore, 40,804 tons have been handled in 20 hr. by two dumpers.

The car dumper, of course, finds its chief use at

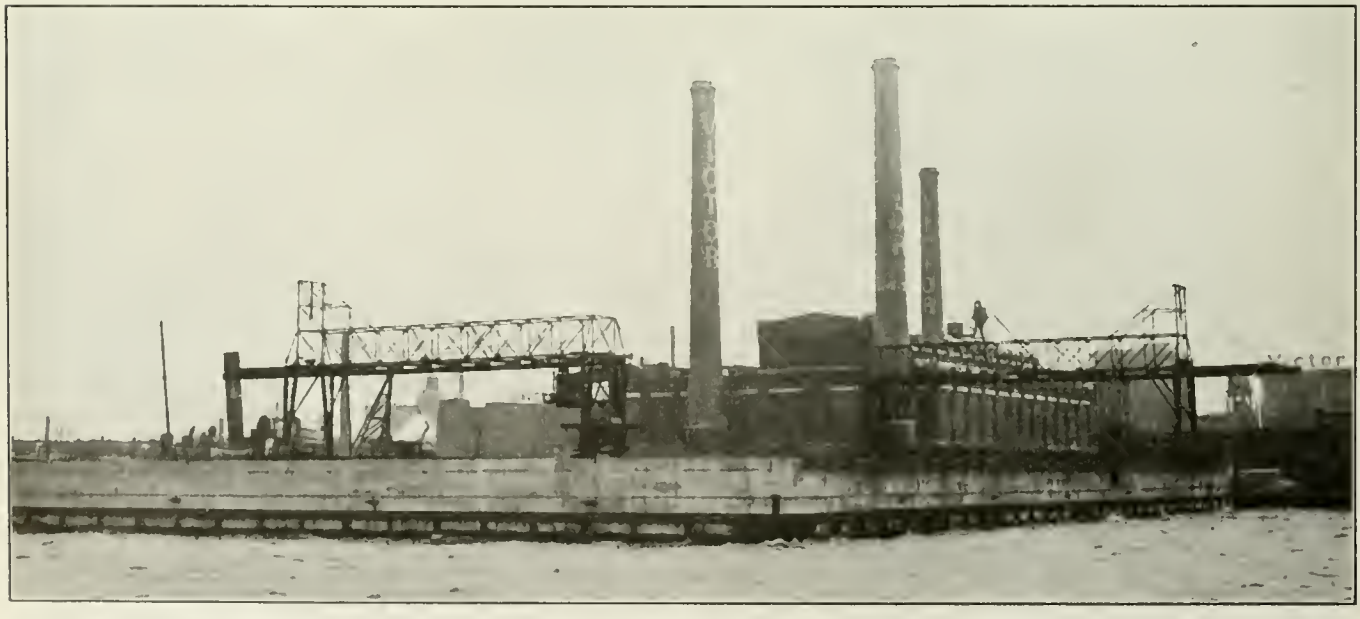


FIG. 7 TRAVELING BRIDGES FOR UNLOADING COAL FROM BARGES AT THE VICTOR TALKING MACHINE COMPANY PLANT

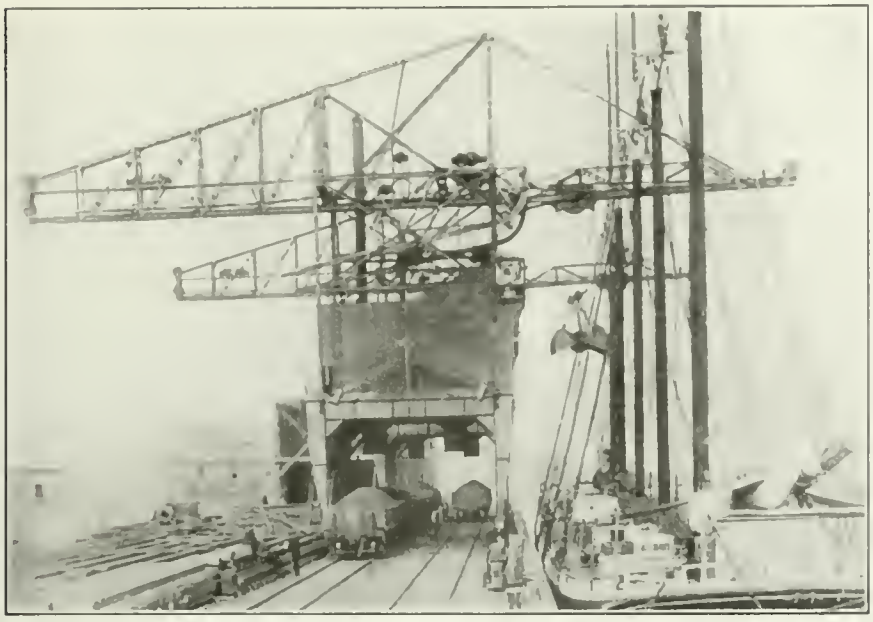


FIG. 8 UNLOADING TOWER FOR WATER-FRONT PLANTS

shipping terminals where coal is discharged into barges for waterfront delivery to large retailers, and into vessels for fueling or for export to distant points.

Fig. 10 illustrates what is really the usual method of handling coal in large industrial plants. The crane shown is of the traveling or unloading bridge type previously mentioned. In many cases it is employed to handle sand, limestone, ore, and other bulk materials in addition to coal.

Such cranes are built in spans ranging from 100 to 300 ft. At each end overhangs provide for access to either railroad cars or storage bins, while the space between the uprights is utilized for piling the fuel. The clearance underneath the crane can be made of any desired amount but is not usually carried beyond a piling height of 40 ft. When bituminous coal is stored fires are likely to break out occasionally if chemical action occurs and the resultant heat is not carried away. Hence, if coal is heaped excessively high, a large volume may have to be handled to get at the burning section.

Unloading bridges are usually operated at a rapid rate. One trip per minute is about the average for the bucket. Smaller size buckets ranging from 3 to 5 cu. yd. capacity are the general rule, although some running as high as from 7 to 11 cu. yd. are in operation. However, the latter are employed in part for handling ore, limestone, and similar materials, and usually unload from boats or barges.

Taking the approximate average weight of bituminous coal at 50 lb. per cu. ft., the capacities in tons per hr. of buckets used in unloading coal, and making one trip per minute, are:

3 cu. yd. bucket, 120 tons per hr.
5 cu. yd. bucket, 200 tons per hr.
7 cu. yd. bucket, 280 tons per hr.
11 cu. yd. bucket, 450 tons per hr.

For unloading coal from cars into boiler-houses or storage areas we have, therefore, the crawler tread crane, the standard gage crane, the wide gage crane, the traveling bridge and the car dumper. For unloading from barges or vessels we have the standard gage crane, the traveling bridge and the unloading tower. In addition, where trestles are available, or where a storage bin adjacent to the boiler-house is equipped with a hopper, either with or without auxiliary bucket elevators, conveying belts or the like, cars can be discharged directly by dumping.

Little can be said about the cost of handling coal. Few figures have been collected from industrial plants because in most places coal handling is only one part of the work assigned to the mechanical equipment installed. Crane costs may be known, but what portion of them should be assigned to coal handling is uncertain.

In cases where cranes or other handling devices are in use entirely for serving fuel requirements we very often find that the majority of applications are in wholesaling or retailing terminals, freight and naval coaling stations, and the like. Figures from these sources are not of much use to an executive in an indus-

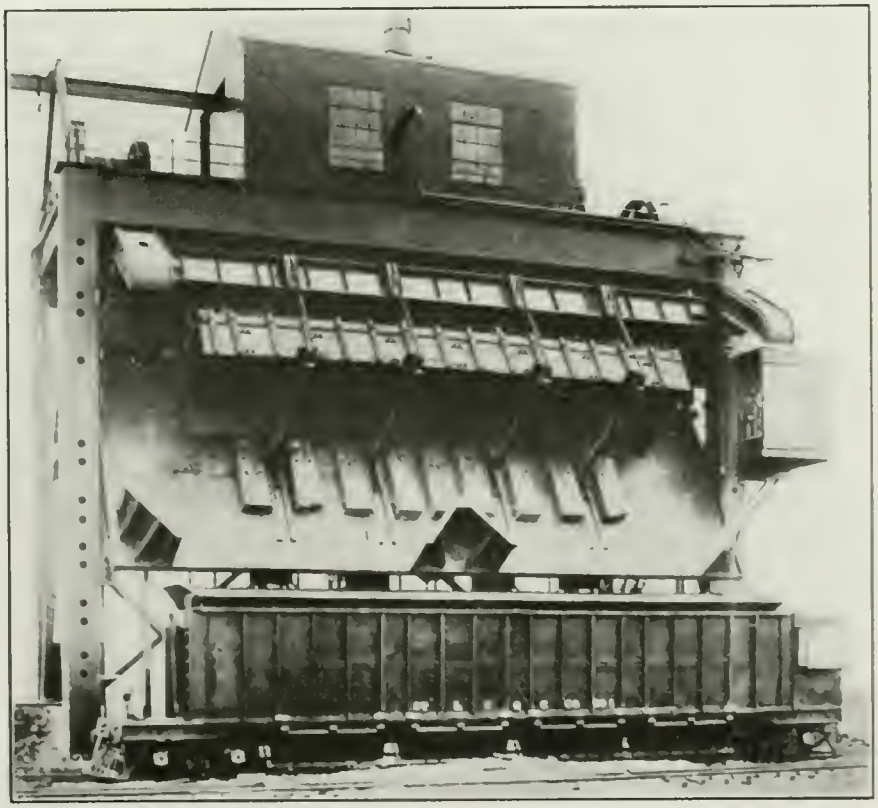


FIG. 9 CAR DUMPING IN AN INDUSTRIAL PLANT

FIG. 10 TRAVELING BRIDGE FOR LARGE SCALE COAL-HANDLING, USED FOR CAR OR BRIDGE DELIVERY

trial plant, because the quantities involved are proportionately too large.

Another factor enters in which, perhaps, is unfamiliar to many who are not in daily contact with the actual operation of handling equipment. Automatic machinery of many kinds runs at a practically constant rate and a large portion of it requires little more than average skill in attendance. The output of material handling equipment, on the contrary, depends to a great extent upon the men who operate it.

In the absence of exact figures it can be stated with assurance that the cost per ton for handling coal by suitable mechanical equipment, in a plant using 10,000 or more tons of the fuel annually, is only from one-third to one-eighth as much as by hand methods when all the overhead charges actually involved are added to direct labor costs in comparing the two methods.

Approximate calculations for the standard gage crane, Fig. 2, on a daily basis, are as follows, although many factors are subject to wide variations:

Capacity per day of 10 hr.....	500 tons
Fuel, 1 ton of coal.....	$5.00
Operator's wages	8.00
Fireman's wages	6.00
Helper's wages	5.00
Burden on direct wage (150 per cent)	28.50
Oil and supplies.....	2.00
Interest on investment ($10,000 at 5 per cent).....	1.66
Taxes, insurance, etc. ($10,000 2½ per cent)	0.83
Repairs and upkeep ($10,000 at 2½ per cent)	0.83
Depreciation and obsolescence ($10,000 at 5 per cent).....	1.66
Total	$59.48
Cost per ton of coal handled.....	$0.119

Calculations for the broad-gage crane in Fig. 4 are, on a daily basis:

Capacity per day of 10 hr.....	1800 tons
Fuel, 3 tons of coal.....	$15.00
Operator's wages	8.00
Fireman's wages	6.00
Helper's wages	5.00
Burden on direct wages (150 per cent)	28.50
Oil and supplies	3.00
Interest on investment ($45,000 at 5 per cent).....	7.48
Taxes, insurance, etc.....	3.66
Repairs and upkeep	3.66
Depreciation and obsolescence....	7.33
Total	$87.63
Cost per ton of coal handled.....	$0.049

Calculations for a traveling bridge crane as shown in Fig. 10, and equipped with an 11 cu. yd. bucket, are, on a daily basis:

Capacity per day of 10 hr.....	4000 tons
Electric current at $0.026 per ton of coal	$104.00
Operator's wages	8.00
Oiler's wages	6.00
Burden on direct wages (150 per cent)	21.00
Oil and supplies	3.00
Interest on investment ($200,000 at 5 per cent).....	33.00
Taxes, insurance, etc.....	16.50
Repairs and upkeep	16.50
Depreciation and obsolescence..	33.00
Total	$241.00
Cost per ton of coal handled....	$0.06

Co-ordination of Production with Sales for Oil Companies

By E. G. REYNOLDS

THE purpose of a method for the co-ordination of production and sales in integrated oil companies is to establish a program which will be useful in long-distance planning; to provide a convenient basis for predetermining consumption and surplus production; and to guide the management in disposing of the surplus production of the refinery to greater advantage.

The detailed classification of the multitudinous by-products obtained by refining a barrel of crude oil is too extensive for the successful development of co-ordination. In order to simplify the use of detailed classification peculiar to the oil industry and to gain a clearer perspective, the refinery output has been divided in this way (Table 1):

TABLE 1. BASIC PRODUCTION OPERATIONS

1. Gasoline
2. Kerosene
   (*a*) Long-time burning oil
   (*b*) Standard white
3. Gas and fuel oil
   (*a*) Under 20 deg.
   (*b*) Over 20 deg.
4. Lubricating oils
   (*a*) Paraffin over 180 deg. viscosity
   (*b*) Paraffin under 180 deg. viscosity
   (*c*) Spindle over 180 deg. viscosity
   (*d*) Spindle under 180 deg. viscosity
   (*e*) Cylinder filtered
   (*f*) Cylinder unfiltered

The marketing of the major products which ultimately assume, through the process of compounding and blending, a variety of trade names, is confined to the domestic, A, and export, B, departments and one wholesale department, C. With the exception of gas and fuel oil, most of the major products for which the character of the demand can be approximately predetermined find an outlet through the two retail departments, as will be described later.

The wholesale department, C, which also functions as a buffer, furnishes an outlet for surplus production, and commitments are made for large shipments several months in advance. It is a function of the wholesale department, C, to dispose of the unsold quota of the domestic, A, and export, B, departments by negotiating in the open market for the best obtainable price, as well as to sell petroleum products at wholesale. A study of price trends of petroleum products determines the amount of stock to keep on hand, since it is the primary object of the management to bring the production and sales departments into co-ordinate development, and thus to increase the accuracy of executive forecasting as to the requirement of each.

Index Number
338:665 Oil Industries. Economic production
658.808 Sales analysis

Before sales can be predetermined by the management and translated into quotas for the retail departments, a physical measurement of the potential gallon consumption in the distributing territory—a market analysis, adjusted for yearly growth—must be made. Fortunately for the oil industry, registration figures for automobiles and trucks offer an excellent index for determining demand for gasoline and motor oil. At this point it is especially interesting to note that all previous production records of cars and trucks were smashed during May 1923, setting a new monthly record of 393,000 cars and trucks. Since fuel oil and kerosene are not susceptible to precise measurements, future requirements must be judged in large measure on the basis of past experience.

After the size of the market for petroleum products is ascertained, the next step is to estimate the percentage of actual business which may reasonably be expected from the total potential business. Past performance furnishes a valuable basis for establishing this percentage. And, if improvement in business conditions seems likely to continue, an increase over the previous years' performance may be expected, in addition to the results accomplished by accelerated sales effort. The condition of company marketing equipment, the character of the market for refined products, and the efficiency of the sales organization are also considered in determining a proper quota.

Philip H. Smith, in an article entitled, "Market Research Increases Motor Truck Sales,"[1] says:

> The method of adjusting territorial sales quotas is much the same as that used in setting production schedules. For the most part they are based on previous sales performance and to that is added what the sales managers think they can do in the coming months or year in the way of improvement. Often there must be more adjustment to fit a predetermined production schedule. In short, the decision is left largely to the sales managers or manager and then adjustment is made with production.

Setting the Production Schedule

The quotas or predetermined sales for the domestic, A, and export, B, departments, provide an excellent basis upon which to plan or schedule refinery operations for the year. With refinery operations scheduled, contracts for crude oil can be judiciously placed. As a result a large fraction of guesswork is eliminated be-

[1] *Automotive Industries*, June 8, 1922.

cause plans rest upon physical measurement of the market translated into quotas for the domestic and export departments.

To quote further from Mr. Smith's article:

> An efficient, accurate production program cannot be set without some knowledge of potential and actual demand. It can be approximated in many cases but no amount of confidence in the superiority of "our product" or the collective judgment of executives can take the place of a scientific study of actual demand.
>
> Most frequently the method employed is for the sales manager and production manager or other executives to get together and set a production schedule based on their judgment of what they think they can dispose of through their selling organization. Territorial sales quotas must then conform to the factory schedule.

In the development of the production schedule, it is necessary to provide a safety margin to absorb spot orders and contingent contracts made through department C. It is one of the functions of the co-ordination technique to provide this department with a sensitive guide which will embody price, production, and consumption variables and which will serve to aid decision to build up or draw upon stocks. For the purpose of obtaining a long-range picture of the available production for the wholesale department, C, estimated requirements of domestic, A, and export departments, B, are subtracted from estimated production.

The method of advance planning is indicated by Table 2:

TABLE 2. ANNUAL ESTIMATES

	Thousand of Barrels	
Gross production schedule	590,000	
Increase in production schedule	10,000	
		600,000
Stocks at beginning of year		100,000
Total		700,000
Dep't A quota	270,000	
Dep't B quota	95,000	
Dep't C quota	260,000	
		625,000
Stocks at end of year		75,000

In addition to establishing a number of barrels of oil available for department C, there must also be considered the monthly adjustment to stocks. The adjustment when price trends are upward is toward stocks of maximum size and just before a decline in prices the adjustment makes for proposed stocks of minimum size. If the management believes that overproduction of gasoline will be extended to excess, it can adopt a policy of carrying minimum stocks of that product. Conversely, if the outlook for gasoline becomes favorable toward the last quarter of the year, a policy of building up stocks is pursued.

In the article previously quoted Mr. Smith wrote:

> A knowledge of business cycles is also of primary importance. Market research will be incomplete and inaccurate unless the existing phase of the business cycle is known and applied to the data at hand. This means that we must know we are on the down-grade or up-grade of business activity.

Adjustment of Estimated Production and Sales

Proposed stocks may be adjusted to the flexible factors of the situation from time to time.

Attempts to estimate future productions and sales may be expected to embody some errors. Sales cannot be predetermined to the last gallon. In order to correct the resultant errors arising from estimating production and sales, the quota established for the wholesale department C, is revised monthly to conform with the physical inventory, thus insuring quotas of considerable accuracy, and delimiting to one month errors in estimating.

Interpretation of the Revised Quota

When interpreting the revised quota, however, the department executive knows that it delimits to one month the possible errors in estimates of surplus production available for his department and that it is evolved from proposed stocks. Therefore, a lowering or raising of the amount of stock that it is proposed to have on hand at the end of the month automatically affects the revised quota, or stock available for the wholesale department C.

For instance, if another department falls short of its quota, department C must make corresponding sales in the open market at the best price obtainable. On the contrary, if departments A and B oversell their quota it reduces the available stock for C. The problem, then, for department C is to forecast the oil available for sale. Table 3 shows the method of calculating the revised quota or oil available which appears in column 7.

For the purpose of a closer check on the operation of departments A and B, a weekly statement of invoice shipments is prepared, showing weekly the percentage of quota reached.

Types of Records Necessary to Execute the Plan

In carrying out the plan established, use of the Gantt progress charts is made. A series of Gantt progress charts, one for each major product, should be prepared for the purpose of showing the progress of the production and sales program. As the record of actual sales and production of finished products is obtained, it is plotted against the quota or plan, so that the chart affords a convenient means for visualizing the plan for sale operations. Reference to Fig. 1 shows the advance made in the execution of the plan at the end of April. Provision has been made for a monthly adjustment of the production schedule to conform to the crude purchase and delivery program. The dotted line indicates the finished stocks of gasoline on hand at the first of the year. Finished stocks at the first of May are represented by the difference between the cumulative production line and the heavy cumulative sales line. A composite picture of all sales is repre-

TABLE 3. WORK SHEET FOR CALCULATING REVISED QUOTA FOR DEPARTMENT C
GASOLINE
The ABC Company

Seasonal for Domestic Consumption	Month	(In 50 Gal. Barrels) 1 Production Schedule	2 Proposed Purchases	3 1+2=3 Combined Pro. Schedule and Purchases	4 Department A Quota	5 Department B Quota	6 3-4+5=6 Available for Department C	7 6±8=7 Revised Quota for Department C	8 10±9=8 Adjustment to Stocks	9 Net Stocks as at First of Month	10 Proposed Stocks End of Month	11 Estimated Price	12 Maximum Storage Facilities
Per Cent													
5	January	40	10	50	5	4	41	41	0	100	100	22	150
4	February	45	15	60	10	6	34	42	−2	123	125	22	150
6	March	50	10	60	15	8	37	39	+2	152	150	23	150
7	April	35	5	40	20	10	10	25	+15	175	160	24	200a
9	May	45	5	50	25	10	15	21	+6	181	175	25	200
10	June	40	10	50	30	12	8				150	26	200
11	July	45	15	60	35	10	15				125	26	200
12	August	35	5	40	40	12	−12				100	25	200
11	September	40	10	50	35	8	7				75	24	200
10	October	40	10	50	25	6	19				50	23	200
9	November	40	10	50	20	4	26				50	21	200
8	December	35	5	40	10	5	25				75	19	200
100%	Year	480	110	600	270	95	235						

a Additional 50,000 gallon tank ready.

sented by the heavy cumulative total sales line. An analysis of this line may be seen by a glance at the operations of the three sales departments plotted on the chart.[2] As already explained, the revised quota acts as a shock-absorber for other departments.

Table 4 shows a work sheet for quota figures and percentages plotted against the plan on the Gantt chart. All calculations are made in terms of barrels, as this is the language of oil executives and instantly depicts the situation for them. All figures are comparable. The difference between gross for the period production plus finished stocks on hand at the beginning of the period and total sales for the period equals finished stocks as at the beginning of the following period. At the end of April the gross production was 993,000 barrels, and 112,000 barrels were sold, leaving 81,000 barrels for building up stocks on hand. Finished stocks at beginning of the year were 100,000 barrels, and adding to this 81,000 barrels unsold equals the finished stocks as at May 1, of 181,000 barrels. Inasmuch as proposed stocks for the end of May were estimated at 175,000 barrels, 6000 barrels of stocks at first

[2] For further explanation, see "The Gantt Chart," by Wallace Clark. The application of the Gantt chart to the method of co-ordination was originally suggested by Joseph I. Pogue, author of "Economics of Petroleum."

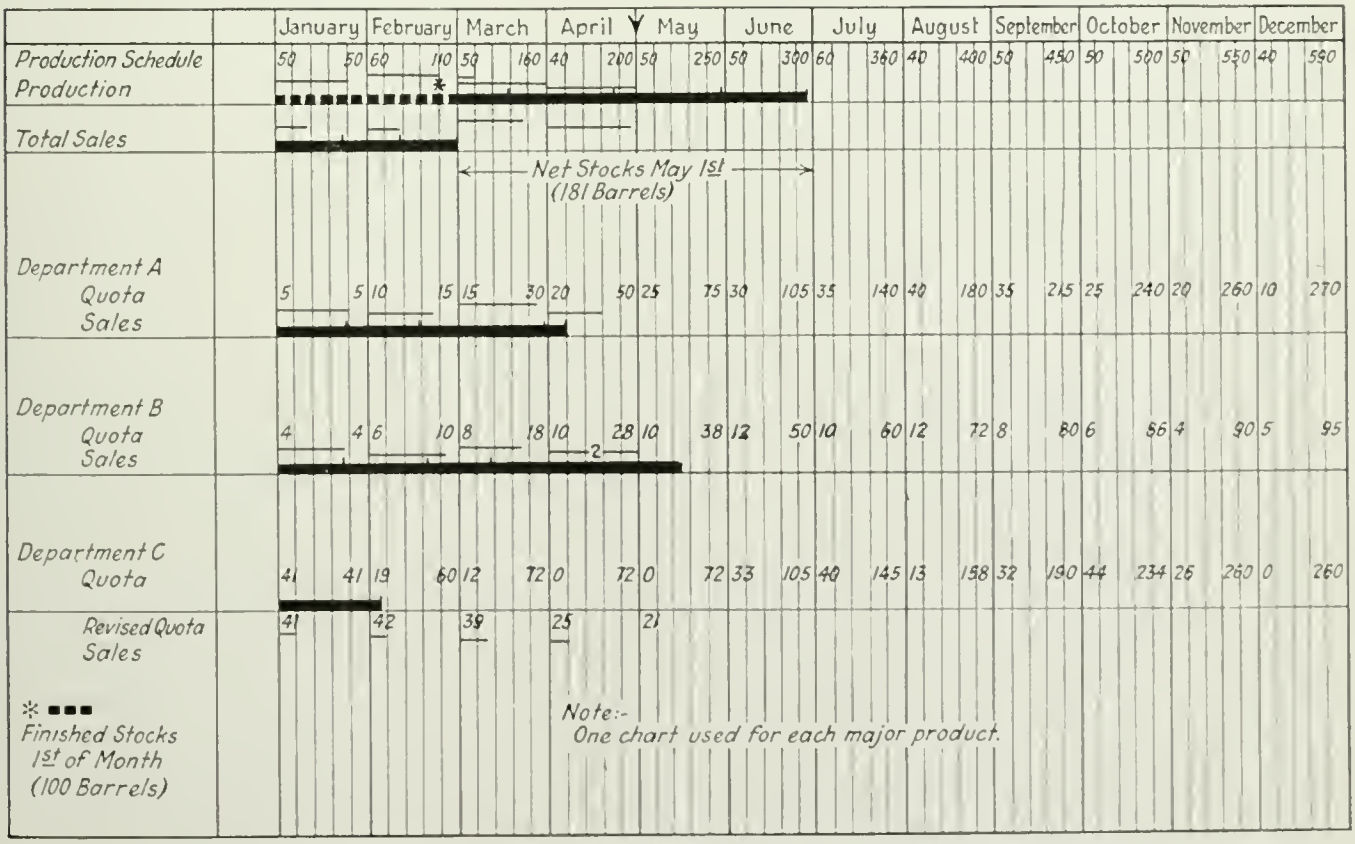


FIG. 1 CO-ORDINATION OF PRODUCTION WITH SALES OF GASOLINE (IN THOUSANDS OF BARRELS)

of month will enter into the revised quota for department C, for the month of May. At first glance one may be confused by the length of cumulative lines of departments A and B. One must bear in mind, however, that these lines are plotted in percentages of quota, whereas the total sales lines are plotted in percentages of production.

Table 4 has been designed so that the cumulative figures required for the progress charts may be easily plotted, thus furnishing the executives a complete check on the entire output.

TABLE 4. WORK SHEET FOR PROGRESS CHARTS

GASOLINE
(In Barrels) The ABC Company

Month	1 Net Production	2 Receipt of Purchases	3 1+2=3 Gross Production	4 5+6+7+8=4 Total Sales	5 Department A	6 Department B	7 Department C	8 Filter Plant Naphtha	9 Remarks
			100a						
January	30	10	40	17	4	3	8	2	
February	40	10	50	21	7	5	7	2	
Cumulative	70	20	190	38	11	8	15	4	
March	50	8	58	35	13	5	14	3	
	120	28	248	73	24	13	29	7	
April	35	10	45	39	10	20	15	4	
	155	38	293	112	34	33	44	11	
May									
June									
July									
August									
September									
October									
November									
December									
Year									

a Finished Stock.
NOTE: One Work Sheet used for each major product.

A study of Table 3 will reveal the method of calculating the revised quota. Similar tables should be prepared for each of the major products classified. Column 7 is the resultant of columns 1 to 6 and 10 to 8, as indicated by the plus and minus signs. This affords a means for calculating the monthly quota and displaying a long-range view of operations. The method is sufficiently adaptable to iron out at any time deviations from the plan. For example, additional storage space was furnished at the end of March by the erection of a 50,000 barrel tank. The form is flexible enough to accommodate further expansion.

Fig. 2 is provided as an advance sheet which places before the executive the most accurate estimates of the oil available for department C immediately after inventory is taken, as well as proposed stocks at the end of the month. Proposed stocks may be adjusted from month to month in the light of the impending trend of prices and storage facilities. The latter, of course, place very definite limitations on the maximum proposed stocks. It is the purpose of this table to equip the executive with a highly sensitive medium of control over operations in advance of the preparation of the progress charts and to give him a device that will sense the pulse of resultant operations in advance. Stock and production figures necessarily are submitted with considerable delay, but approximate stocks at the first of the month can be ascertained immediately and used as a basis for the month's operations, instead of waiting for the first weeks of the month's operations to transpire.

The subject of prices is of continual anxiety to the oil man. Probably no industry experiences such violent fluctuations in receiving periods of prosperity and depression as does the oil industry. Production, stimulated or retarded by prospective profits, introduces an elastic factor in the price structure to which refined products speedily respond. This elastic movement of prices may be translated into profit or loss with amazing promptness.

How, then, can the oil executive place himself on the sunny side of the inventory price adjustment? In 1921 crude oil—the raw material of the industry—mounted to tottering heights. A study of such a

COORDINATION OF REFINERY OPERATIONS WITH SALES
REVISED QUOTAS FOR MONTH AND PROPOSED STOCKS AT END OF MONTH
(In 50 Gallon Barrels)

Reported by Cost Dept.

	Gasoline		Long Time Burning Oil		Standard White Oil		Gas & Fuel Oil under 20°		Gas & Fuel Oil over 20°		Paraffin over 180°		Paraffin under 180°		Spindle over 180°		Spindle under 180°		Cylinder Filtered	
	Revised Quota	Proposed Stocks	Revised Quota	Proposed Stocks	Revised Quota	Proposed Stocks	Revised Quota	Proposed Stocks	Revised Quota	Proposed Stocks	Revised Quota	Proposed Stocks	Revised Quota	Proposed Stocks	Revised Quota	Proposed Stocks	Revised Quota	Proposed Stocks	Revised Quota	Proposed Stocks
January	41	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
February	42	125	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
March	39	150	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
April	25	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
May	21	175	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
June		150	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
July		125	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
August		100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
September		75		—		—		—		—		—		—		—		—		—
October		50		—		—		—		—		—		—		—		—		—
November		50		—		—		—		—		—		—		—		—		—
December		75		—		—		—		—		—		—		—		—		—
Note:- Proposed Stocks as at end of Month.																				

FIG. 2 ADVANCE DESK SHEET FOR EXECUTIVES

severe maladjustment would have disclosed to the executive the inevitable slump which occurred in that year, thus providing him with an opportunity to provide storage for the subsequent purchase of crude oil at low prices.

Tendency of Prices

Major movements of prices may be traced plainly enough by the oil man who devotes patient attention to a study of the situation. Fig. 2 compares relative prices of petroleum products plotted against the price level of all commodities as determined by the U. S. Bureau of Labor statistics index number and shows the diversity of the fluctuations of refined products about the general price level. An outstanding feature of the chart is the tendency of prices, both of crude oil and refined products, to remain longer below the general price level than above.

In an address[3] delivered on April 12, 1923, by Roy B. Jones, President of the Pan-Handle Producing and Refining Company, at the convention of the Western Petroleum Refiners Association held at Galveston, Texas, Mr. Jones said: "It seems to me that we should regulate our output to suit our storage facilities and market requirements and at least realize our cost from our products. I know that many of us, if not most of us, have at times operated at a loss and have made no attempt to regulate our output to seasonable demands. When such conditions obtain, many small refiners curtail the run or cease operations altogether."

Regulation of Refinery Operations

The problem of financing is intimately related to an inventory policy. Taking advantage of price fluctuations is frequently hampered by contracts which must be made in advance, particularly in competitive bidding for high-priced crude. A refusal to accept the high-grade crude of the numerous independent producers will divert their production into the hands of competitors who are always ready to insure for themselves a stable supply of raw material. Crude cannot be purchased at the whim and fancy of the refiner, unless high prices are paid. Losses, however, can be mitigated by placing contracts either during times of low prices, or on the eve of a rise in prices. In addition, stocks in excess of immediate requirements may be sold in the open market and repurchased at lower prices. In the falling market for instance, hand-to-mouth buying prevails and crude is easily purchasable in necessary quantities.

The adjustment of refinery operations to a fluctuating demand for refined products presents a vital problem to the management. The sooner and the more accurately the demand can be measured in advance, the better is the position of the management to contract at advantageous prices for crude oil. Many oil companies together with industrial corporations suffered severe losses due to decline in demand, and the sharp falling of prices in 1921. The severity of this depression has not been wholly forgotten and a quite natural, conservative behavior on the part of many oil executives now prevails.

Now, unless the refining schedule has been attuned, both as to supply of crude and refinery equipment, a sharp acceleration in demand may influence the sales departments to assume obligations which the company cannot profitably meet. It may become necessary to go out into the open market to purchase refined products, the price of which reflects the excess cost of refined products based upon the prevailing price of crude and labor cost. Entering the period of falling prices with a large stock of petroleum products, manufactured from high-priced labor and crude, results in financial losses that more than offset the hundred and one economies that may have been instituted. Obviously, it would be better to sell petroleum products slightly under the market than to hold them for a sharp recession in prices and consequent losses of greater magnitude.

Objections to Adapting Policies to Price Fluctuations

One of the most serious objections to adapting policies to take advantage of price fluctuations is the matter of financing the building up of inventories and physical expansions in periods of depression which result in a low cost of operations and wider profit margin. Storage capacity for huge inventories must be provided. Money tied up in stocks, to be profitable, must be compensated by an increased realization. Also, additional risk through the possible lack of transportation facilities must be weighted in considering a fixed policy.

Above all, full utilization must be made of the best available information which will throw light on the future movements of prices. The tendency of the larger producing pools to decline in output and the ever-shifting sources of crude supply interject a factor of stabilization into the continual gyrations of oil prices which may support a gradually upward trend in the face of a declining demand.

Co-ordination of Production and Sales

Successful co-ordination of production and sales in integrated oil industries may be obtained by:

1. Analysis of the size and character of the market.
2. Economic studies forecasting the trend of the potential market.
3. Predetermination of what the sales performance should be, or establishment of quotas, based upon physical measurement of the market.
4. Setting a production schedule to conform with predetermined sales.
5. Basing purchase program of crude oil upon production schedule.
6. Developing a device for making monthly estimates of surplus production and the regulation of its disposal to fluctuations in prices.
7. Providing records which will reflect the progress of refinery operations and department sales.
8. Studying price relationships.

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[3] *National Petroleum News*, April 18, 1923.

THE EDITORS' PAGE

The Banker's Business Service

MR. WILLIS, in an article appearing elsewhere in MANAGEMENT AND ADMINISTRATION, points out the conditions which should govern the selection of a bank. In practice such a selection is usually happy-go-lucky. A friend is in a bank, an acquaintance recommends a bank, or perhaps a bank is near at hand, and, without investigation or any special consideration an alliance is made—if the bank is willing.

The results of this haphazard method of selecting a bank are not usually disastrous. In some cases the plan works well. In most cases, however, it means the loss of banking assistance and facilities that might be of very great value.

For instance, a garment manufacturer in the domestic market may "couple up" with a bank specializing in foreign trade. The manufacturer thereby secures a bank of deposit and may secure a fair line of credit, but he cannot avail himself of the special facilities for export trade offered by his bank, nor does he receive the attention and help that a better selected bank could offer.

Then again, from the standpoint of size, the "selected" bank may be so large that it takes but little interest in the small concern, or it may be so small that the legal limit on its loans prevents it from giving its depositor the credit to which he is entitled.

One common cause of this carelessness in the selection of a bank is the failure to appreciate the important part banks play in modern business. This is true more particularly of the smaller concerns. Their immediate need is a place to deposit money. Almost any modern bank is good enough for this, and the first bank that offers is taken—the other functions of the bank are ignored. Then when other service that a bank might give is needed, it, perhaps, is not forthcoming because the selected bank does not cover that field.

The modern bank is not only a place of deposit and an agency for the extension of credit but, for his depositors, the banker himself is an interested counselor, guide, and friend. He is able to analyze a financial statement, to point out what should be built up and what should be cut down. He is able—or should be able—to point out too small a margin of profit or too large an expense burden—to show where and how bills may be discounted to advantage, to suggest a better handling of credit. In short, properly used, the bank without expense to him places at the disposal of the business man a service that he could hardly find elsewhere.

One point that cannot be too strongly emphasized is the fact that a "misfit" banking connection which may operate fairly well under ordinary conditions is liable to break down in times of trouble—just when it is most needed—and bring disaster. In this, as in all financial matters, care must be taken before the event. If not done then it is usually too late.

Mr. Willis' article describes in considerable detail the assistance that the modern bank can offer its clientele. He also explains, as already stated, the conditions which should govern its selection. The article will well repay a careful study.

The Cyclical Trend in Industry

FURTHER improvements in the department on Conditions and Prospects in Business and Industry have been put into effect with the publishing of the present issue. After gathering and weighting statistics on most of the charts which had not thus far been corrected for seasonal fluctuations, Dr. Haney has made adjustments which eliminate seasonal variations and give the curves added significance. They are now true indicators of cyclical trends in all cases where data are available running back a sufficient number of years to insure a reliable basis for such a correction.

For instance, retail trade is brisk during the season leading up to Christmas, and curves showing sales totals in actual dollars, or direct index numbers, reach peaks which may not after all indicate comparative growth over previous months. Business men desire to know whether trade has shown an actual development due to a real upward trend, or whether the seasonal advance hides a tendency which is downward.

To the charts showing the employment situation and wage variations have been added curves for the state of Wisconsin. Previously the figures were given only for the United States and the state of New York. Since the data from all three sources are most carefully compiled, the additional curves will prove to be excellent indicators to compare the Middle West with the East and with the country as a whole.

Interest in Management

MANAGEMENT WEEK, 1922, was projected as a hopeful experiment and fulfilled in large measure the expectations of its promoters. In fact the substantial success secured warranted the plans for Management Week, 1923. A review of the meetings held forces the conclusion that at no time in the past has there been so much interest in this subject as prevails today.

Some 40 sessions were held in nearly as many cities stretching from Boston to Portland and Seattle, and from Minneapolis and Duluth to Birmingham and Atlanta. Five societies co-operated in preparing the programs and securing the attendance. But many other organizations aided, as Rotary and Kiwanis Clubs, and the faculties of engineering schools. The presence of business men was a feature of the gatherings.

The topics discussed were nearly as widespread as the locations of the meetings. The measurement of

management, personnel management, industrial legislation, accounting, the banker and management, standardization and management, are typical. Others were more specific as "Foundry Management," "Industrial Management as Applied to Steel Plants," and "Cost Accounting in Cement Manufacture."

Those who have been doubtful over the progress which good management has been making in American industry should take heart. When a topic grips all parts of the country, appeals to engineers, manufacturers, business men, and educators alike, and brings forth such a variety of treatment real interest has been aroused.

MANAGEMENT AND ADMINISTRATION congratulates all who had anything to do with Management Week in 1923, and hopes that early plans may be made for 1924. A project so large in its idea, so far flung in the execution, requires management of a high order, and a policy worked out months in advance. May every major industrial center in the United States participate in Management Week this year, thus advancing the controlled operation of our industrial enterprise.

The Administration of General Motors

EXECUTIVES in big concerns are keen to keep pace with latest developments in the control of large-scale production, while the men responsible for the management of smaller industrial enterprises are continually on the alert for ideas and methods that will ultimately land them and their organization in the select company of the "big fellows".

The obvious hunger of American industrial executives for "experience articles" is easily diagnosed. From theory, unrelieved and unsupported by practical application, they turn to the personal testimony of men actually busy on the job, feeling that one page telling how the thing has been done is worth a dozen on beautiful theories as to how it ought to be.

In view of this demand for articles telling frankly and in adequate detail how difficult problems of management have been wrestled with and solved, a number of executives connected with the present management of General Motors Corporation have agreed to share with the readers of this publication their experience in the "tuning up" of a great modern industrial corporation.

As is well known, General Motors is from every point of view one of the outstanding industrial developments of today, embracing 33 manufacturing organizations, 28 sales companies, and 10 miscellaneous units. The combined assets of the 71 units amount approximately to a half billion dollars.

The General Motors series begins in this issue with an article by Alfred H. Swayne, Vice-President of General Motors Corporation, who is in charge of the banking relations of the organization. This first chapter of the story of administrative control in General Motors, under the title "Mobilization of Cash Reserves," is concerned with the vital matter of working capital. It tells how, by making money more fluid than ever before, the corporation has reduced its "float" from ten millions to about four, with a considerable interest saving.

In addition to this notable achievement of economy in the use of working capital, the present management of General Motors has also materially reduced the loss of time and money formerly involved in transactions between the various units of the corporation. Still other savings have been effected by cutting down the number of contingent accounts, such as petty cash and other small funds, comparatively insignificant in the unit but very significant in the aggregate.

In addition to Mr. Swayne, Vice-Presidents Donaldson Brown and C. S. Mott, and E. Karl Wennerlund, Head of the Department of Factory Organization, are among those who will contribute articles to the series. A few of the topics to be discussed will be the general plan of financial control; the theory of price determination; the staff organization by which the interests of the various units are correlated and harmonized; and the method of materials control, which is on a quantity rather than a money basis.

General Motors, since its organization, and particularly since its reorganization, has held the interest of the average American as few of the large industrial combinations have been able to do. Just now the corporation, because of its recently announced plan for managerial profit-sharing through stock ownership, is "in the public eye" to a remarkable degree. It therefore seems likely that the General Motors series in MANAGEMENT AND ADMINISTRATION will receive the attention, not only of the industrial executives for whom it is particularly intended, but of many general readers as well.

Management Advantage

THE term "mechanical advantage" is familiar to all who are concerned with machinery. It refers to the multiplication of a given force through an intermediate mechanism to many times its original value. One pound acting on a lever arm of 10 ft. will counterbalance 10 lb. on a lever arm of 1 ft.

"Management advantage" is a term suggested to explain a similar performance in the field of industrial operations. Leaders in the business world have invariably succeeded in putting across big programs of development by building and using the intermediate mechanism of organization. Groups of expert assistants accomplish results absolutely impossible for one man alone. These men, in turn, multiply their powers manifold by dividing the duties allotted to them among capable subordinates. At the final end of each line of authority are those who actually perform the separate details of work, many thousand times as much as can be accomplished by the master mind of the enterprise as an individual.

In addition to organization the executive has at his disposal other mechanisms which increase his powers tremendously: management methods; financial control; engineering, production, and sales programs; charts and records and a multitude of time- and labor-saving devices are a few of the many elements which the business genius combines with the human part of his organization by intelligent selection and application to form the complete mechanism for carrying out his comprehensive plans.

THE READERS' PAGE

Codes of Office Management

THIS letter, of particular interest to office managers, is from the Secretary of the National Association of Office Managers, whose business connection is with the Retail Credit Company, Inc., of Atlanta, Georgia.

Editors of MANAGEMENT AND ADMINISTRATION:

Two of the most illuminating addresses at the recent convention of our Association held in Detroit were by B. F. Young of the New York Telephone Company and Harry A. Hopf, Management Engineer, of New York.

I believe that the readers of MANAGEMENT AND ADMINISTRATION will be interested in brief excerpts from these addresses, as together they make a real contribution to a well-rounded program of office management.

In his address on "Organizing the Office for Large Scale Production" Mr. Young submitted the following under the heading of "A Few Broad Principles":

General

1. Select a high type of supervisors and place responsibilities on them.
2. Hold frequent conference discussions with them.

Personnel

1. Engage only the better, more conscientious type of office workers.
2. Develop a positive rather than a negative disciplinary policy, designed to make the employee feel that he is working with the management for the accomplishment of certain ends and that the management is ever sensitive to his welfare.
3. Establish a positive salary treatment making individual increases the rule, and failure to get an increase the exception.
4. Make only such investment in employees' service activities as will result in a benefit to the company and the employees.
5. Provide means whereby any employee may have ready access to the management.

Planning the Work

1. Make a scientific distribution of the work.
2. Develop serviceable, but guard against non-serviceable, job analysis.

Doing the Work

1. Develop a mobile force.
2. Maintain supervision and control through carefully prepared and controlled written instructions and routine reports.
3. Utilize mechanical aids wherever it is economical to do so.

Mr. Hopf's topic was "A Practical Method of Solving the Salary Problem." At the outset he offered six "basic obligations of management," as follows:

1. To select the best possible human material for the position to be filled.
2. To place and train employees so that they will do their work most effectively.
3. To furnish them with a scientifically determined and constructed plan of remuneration which will commend itself by the fairness of its basis, the sane liberality of its provisions, and the effectiveness of its application to the measurement of individual merit.
4. To protect and guard their physical, mental, and moral welfare.
5. To inspire and lead them, and to provide opportunities for them to progress to higher levels in productive life.
6. And last, to eliminate the superannuated and unfit by just but not harsh methods, and to provide means whereby they may spend the final period of their lives in comparative comfort.

This emphasis on *responsibility* and frank recognition of *obligations* to the great body of employees, constitute one of the most significant tendencies in modern management.

T. G. WOOLFORD

Mathematics Applied to a Business Problem

Editors of MANAGEMENT AND ADMINISTRATION:

Readers of MANAGEMENT AND ADMINISTRATION have shown a strong preference for what the editors term "experience articles". The following, from an accountant connected with A. H. Whan & Company, might be called an "experience letter":

The advantage of mathematical training to an accountant has been discussed often enough to prove to the members of the profession that it should be given serious consideration. Still it is very seldom that one encounters men who possess more than a very hazy idea about logarithms, progressions, or even algebra in general.

In my own experience I have been faced so often by problems requiring more than a superficial knowledge in mathematics, that I am constantly studying my favorite science. Such study cannot be recommended too warmly to accountants in general, as it will enable them not only to demonstrate their superiority in concrete cases, but it also broadens their minds and reasoning capacity.

Plain algebra very often will be of great assistance to the practitioner in arriving at taxes and bonuses, where each is deductible from income before the other can be determined, or in calculating unit selling prices by the estimating departments of factories, etc. Higher mathematics, like algebraic analysis and the rudiments of infinitesimal calculus are needed for the problems concerning continuous compound interest, and actuarial work in insurance companies. But even in common, everyday business, cases requiring a thorough knowledge of the highest branch in the mathematical science

will present themselves to the accountant, as will be shown by the following example which actually confronted me some time ago.

A diamond merchant purchased uncut diamonds of large sizes for $240,000. When the stones were received it was found that their shapes were such as to exclude cutting. It would be necessary to split the stones in two; $180,000 worth of stones were to be split and therefore shipped to a diamond cutter. The value of large stones being proportionate to the square of their weight, a considerable loss naturally will be the result of splitting them. It was decided to set up a reserve account for the loss in value, but the amount of such reserve had to be within reason, and it had to "hold water." As it was impossible to determine the weight of the resulting pieces, the value of the lot after splitting could be determined only as follows:

Weight of stone	$= w$
Unit price	$= p$
Value of stone before cutting	$= pw^2$

The "expected value" of an occurrence is equal to the price to be obtained multiplied by the mathematical probabilities that it will actually occur, hence:

The probabilities that one resulting piece will weigh x carat or $x + dx$ carat (d = differential) is $\frac{dx}{w}$.

The mathematical chance that a piece of a certain weight will result is expressed by a fraction as follows:

$$\frac{\text{favorable cases}}{\text{possible cases}}$$

We can easily find a mathematical value for the possible cases by taking the original weight as a basis, viz: $c.w.$ wherein c is a constant having infinitely numerous possibilities; for the favorable cases we can take the differential of the resulting weight as the basis and multiply it by the same constant so that the mathematical probabilities that our piece will weigh x carat (the other w—x carat) can be expressed by the following formula:

$$\text{Probabilities} = \frac{d \,.\, x \,.\, c}{w \,.\, c} = \frac{d \,.\, x}{w}$$

The differential value of the resulting pieces after splitting will be:

$$dv = p \,.\, x^2 \,.\, \frac{dx}{w} \;\ldots \text{ and } dv^1 = p\,(w-x)^2 \,\frac{dx}{v} \;\ldots \text{ or } d(v+v^1) = \frac{p}{w}\,(2x^2 - 2wx + w^2)\,dx$$

x can assume any value from 0 (naught) to w, and the value of both pieces will be:

$$v + v^1 = \frac{p}{w} \int_0^w (2x^2 - 2wx + w^2)\,dx$$

$$\text{or } \ldots\; v + v^1 = \frac{p}{w} \,.\, (\tfrac{2}{3}x^3 - wx^2 + w^2x) + c$$

c being the constant of integration. Substituting the values $x = o$ and $x = w$ in the above formula, and subtracting we obtain:

$$\text{for } x = w \qquad v + v^1 = \begin{cases} \frac{p}{w}\,(\quad - w^2 + w^2) + C \\ \text{for } x = o \qquad \frac{p}{w}\,(\quad o - w\,o + w\,o) + C \end{cases} \quad \text{subtracted from the above}$$

$$v + v^1 = \frac{p}{w}\,(\quad w^2) = \tfrac{1}{3}\,p \,.\, w \qquad (p\,w = \text{value before splitting})$$

According to the above formula the value of the stones after splitting is "expected" to be 2/3 of the value of the stones before splitting, so that in the case under discussion, the reserve to be set aside should be 1/3 of the cost or $60,000.

A. L. GARELS.

Profit-Sharing in England

THE letter which follows is from the administrative assistant to B. S. Rowntree, of Rowntree and Company, Ltd., manufacturers of cocoa and chocolates, with factories at York, England, employing more than 2000 operatives:

Editors of MANAGEMENT AND ADMINISTRATION:

In a recent issue of MANAGEMENT AND ADMINISTRATION Mr. Joseph Mayer stated some results of an American inquiry into American profit-sharing experience. The conclusions arrived at as a result of a contemporaneous and not less exhaustive British inquiry into upwards of 600 British and American schemes may be of interest, particularly as this inquiry was carried out for and under the control of Mr. B. S. Rowntree, and as a result of it a profit-sharing scheme has been adopted by Rowntree and Company, Ltd. I propose, first, to state our general conclusions; secondly, to deal with the chief difficulties raised by Mr. Mayer; and finally, to give brief particulars of the Rowntree scheme. The conclusions, though stated in abstract terms, are based on an analysis of carefully sifted facts, but considerations of space preclude the statement here of any details.

Conflicting Views

For some reason profit-sharing, at any rate in England, seems, as a rule, to produce either passionate devotees or bitter and cynical critics. On the one hand, we have a band of employers (and employed) preaching profit-sharing and co-partnership with the earnestness almost of a religion. On the other hand, are employers deriding it as weak-kneed, illogical, and thoroughly unsuccessful sentimentalism, and labor leaders denouncing it as the last tricky ruse of a panicky capitalism. Where does the truth lie? Is profit-sharing the solution of present industrial problems? Can it at least make some substantial contribution? Or is it merely a bee in the bonnets of a few cranks and fanatics? Let us view the matter dispassionately.

The advocates of profit-sharing tend often to state their case something like the following paragraph:

Successful production depends upon employer and employed pulling together. Under modern industrial conditions the employee has no financial interest in ultimate results: he has his fixed trade union or district rate of wage and no more. Herein lies the explanation of all our difficulties. Give him some share in the year's profits (if any) and his attitude will be revolutionized. *His pocket being now linked with the success of the firm* he will work day by day at the bench as if the business were his own. Profit-sharing is the solution of all our industrial ills!

The critic's reply to this is briefly "stuff and nonsense;" and as an answer to the case *as stated above* this is broadly correct. It is true that if one wants a worker to do his best at a job which possesses no intrinsic interest, his reward should vary with his efforts. With people and things as they are, that is almost axiomatic. So far our profit-sharer is right. But he is wrong if he thinks profit-sharing is, in the general case, a suitable method of achieving this end.

Payment by Results

To secure day by day effort at a monotonous job one wants a method of payment by results which satisfies three conditions, namely:

1. That the reward is directly proportioned to the effort of the individual (or, in some cases, of a closely identified group).
2. That it follows quickly after the effort.
3. That it is on an easily calculable basis.

Profit-sharing in theory satisfies none of these conditions. Investigation showed this to be entirely borne out in practice. So far the critics are on absolutely safe ground.

A Different Viewpoint

But does this end the matter? I want to submit that it does not. That in approaching the question in this way both advocate and critic are adopting too narrow a viewpoint altogether. There is a wider one.

The most difficult and perplexing problem in industry today is that of human relationships. Our mechanics are a century ahead of our psychology. Broadly speaking in dealing with employees an employer has a choice of two alternatives. He may seek to secure good service by a policy founded on the fear motive —by stern supervision and ruthless firing. On the other hand he may believe that this policy is today impracticable, socially undesirable, or economically unprofitable. In that event he must stake everything on securing a spirit of willing service. In this view masterdom, like serfdom, is out of date. We have to secure the voluntary and cordial pulling together of all those engaged in the enterprise.

Approaching the matter on these lines, things take a different perspective. We see profit-sharing from a new angle. We have, as we have said, to give the worker a direct financial interest in his daily efforts, and profit-sharing, it is true, is not the best way to do this. Agreed. But we have to do more than this: We have to create an "atmosphere" favorable to cordial co-operation. Here it is that profit-sharing finds its place. It is true that it is no panacea. It is only one thing among several, but it is submitted that it, or something equivalent, will be found to be an essential element.

If this favorable atmosphere is to be obtained, various conditions must be fulfilled. The worker must be suited to the work. His working conditions must be decent. He must feel a certain measure of security for the future. He must be sensibly handled by men he can respect and follow. He must have at least a voice in the determination of his day-by-day conditions.

The Worker's Share

But all these things will fail by themselves to achieve the end desired unless the worker feels that he is getting a fair share of the ultimate product. This means, of course, adequate wages, but it means more than that. The atmosphere we want will never be fully secured so long as there is a fundamental divergence of ultimate financial interests. It may be possible as a matter of abstract economic theory to show a direct relationship between wage rates in 1925 and effort in 1923. Even so, however, this is too remote. So long as every additional effort *seems* to the worker calculated merely to swell the profits of unknown shareholders, full co-operation and leadership are out of the question. The works manager is put in a false position. Once we reject the idea of rule by force and fear we must go forward and agree on some distribution of the ultimate product which is generally accepted as fair. This does not necessarily mean that labor in every case is to get more. It does mean that labor shall know first what the profits are; and secondly that if, as things turn out, wages have not given an adequate share of the product, the advantage will not be wholly taken by inert capital. In other words, profit-sharing, or its equivalent, is a guarantee of an equitable distribution on an agreed basis. We must regard it not primarily from the financial but from the psychological point of view.

To sum up, profit-sharing as a method of payment by results is a failure. Furthermore it is not a substitute for good management. Nevertheless, it, or its equivalent, has an essential function to perform in the industry of the future, in that it is one of the factors essential to the securing of harmony and co-operation. An electric bulb is not to be condemned as useless because it will not fry potatoes! Its purpose is to create light.

Education

But if profit-sharing is the keystone, education is most certainly the mortar. We have already suggested that all the conditions mentioned above are necessary to achieve the desired results, and not just a selection of them. If one be omitted the design will fail. But further, all together may fail unless there is a successful attempt to explain to all concerned the purposes underlying the whole, and the relationship

of the different factors in the business to one another. This brings us to the first of Mr. Mayer's three main difficulties. This is, that after a time the worker begins to regard his share of profits as part of his regular remuneration, to base his standard of life on it, and to be discontented and annoyed when it diminishes or disappears. The answer to this is that it is the business of the employer, by education, to see that the worker *does* appreciate the true nature of profit-sharing. Crowding together into cities leads to certain hygienic difficulties; but we do not in consequence refrain from living in cities; we take steps rather to guard against these difficulties. Similarly with profit-sharing—it may be turned down on the ground that its success will necessitate the education of employees in the elements of economics. It should rather be adopted on the ground that it supplies a unique opportunity for "putting over" this education, with all its resultant advantages.

The second difficulty put by Mr. Mayer is that the worker will begin to think that he has a "right" to his share of profits. The answer to this surely is that he *has* a right to this so long as the agreement continues. The employer deliberately creates this right in anticipation of a certain resulting advantage; and here again it is his business, by education, to see that the worker appreciates duties arising out of this right.

Management Sharing

The third and main difficulty is that profit-sharing will lead to management-sharing. The answer is in part that this depends on what is meant by management-sharing, and for the rest that in so far as it is true it should be regarded as a good thing. A pessimist is one who regards every opportunity as a difficulty. An optimist is one who regards every difficulty as an opportunity. The employer who has adopted profit-sharing will be one of the optimist type. He has wished to interest his workers in the fortunes of the whole organization. If he finds that, as a result of profit-sharing his workers are becoming more interested in the working of the business, more desirous of making suggestions, and more critical of mismanagement, he will welcome this. It is just what he wanted, only more so! It is conceivable that some of their proposals may be unwise. It is just conceivable, for example, that they may want to elect foremen or do executive work by joint committees. It will be then up to him to show that, contrary to their intentions, this would weaken the business rather than strengthen it. Here again is his opportunity to instruct them in business fundamentals. An employer who adopts profit-sharing for the reasons we have suggested will be one who already consults his employees. Any developing interest in the affairs of the business, properly handled, will only provide an opportunity for wider and more fruitful consultation and co-operation with the worker.

If, therefore, an employer is prepared to face the task of education, he will find profit-sharing in some form an essential and an opportunity; and what is more he will gain ultimately both in results and in pleasure in their achievement. He is the long view man. If in his heart he is afraid of education, then he had better steer clear of profit-sharing and its consequences and be content with the second rate. Or so at any rate it appears to the writer.

The Rowntree Scheme

And now for very brief particulars of the Rowntree "scheme."

1. Labor receives its agreed wage. Then capital receives its agreed wage. Next, certain amounts are put to reserve so as to safeguard the business in the future. Then out of any remaining profits there may be at the end of any year—five-tenths, which goes to labor, and one-tenth to directors; leaving four-tenths for capital.

2. "Labor's wage" consists of wages and salaries due under the usual trade union or other agreements. That is to say, they are exactly the same as would be paid if there were no profit-sharing scheme.

3. "Capital's wage" is $7\frac{1}{2}$ per cent on the amount of the "capital." This $7\frac{1}{2}$ per cent is 1 per cent more than the average dividend on preference shares. The balance left for the ordinary shareholder is therefore more than $7\frac{1}{2}$ per cent. This wage is cumulative.

4. The capital on which capital's wage is calculated consisted at the beginning of the scheme of:

(*a*) The issued share capital; together with
(*b*) The reserves, and other profits earned up to December 31, 1922, and left in the business.

This amount is increased when new capital is brought in and is reduced when reserves are paid out.

5. Certain reserves are set aside after providing capital with its wage:

(*a*) A dividend equalization reserve. The amount to be set aside annually out of profits is £20,000, or 10 per cent of the profits remaining after providing for capital's wage for the year, whichever is the greater. This reserve is not to exceed one year's wage of capital.
(*b*) An advertising reserve. The amount to be set aside from time to time is left to the directors, but the total is not to exceed 10 per cent on the capital without the consent of the profit-sharing committee.
(*c*) A special reserve. This is a discretionary provision to meet special circumstances, of which the recent war is an example.

A point to be noted, is that (with a possible minor exception in the case of reserve (*c*) all these reserves are ultimately brought back into the pool and distributed under the terms of the "scheme." They do not belong alone to capital.

6. After providing for labor's wage, then for capital's wage, and then for these reserves, one-half of any remaining profits in any year is set aside as labor's share.

7. Labor's share is in any year divided among all employees who:

(*a*) Have been continuously employed for not less than four complete quarters.
(*b*) Who have attained 18.

They share as from the first quarter day after they become eligible. Short time, justifiable absence through illness, and so on, are not to be regarded as breaks in employment for this purpose. An employee's share of profits is forfeited if he is dismissed for wilful default or misconduct, or if he improperly discloses confidential information or attempts to sell or mortgage his share, or if he does not claim it for 12 months. Any such sum so far as it is not used for the benefit of the employee or his dependents is added to labor's share for the next year.

8. Labor's share of profits in any year is divided as an equal percentage on the earnings of all those entitled to share.

9. An employee's share of profits is paid into such banking account as he may request. In the absence of such request it is paid into the York Savings Bank.

When the directors decide that it would be contrary to the interests of the company to pay in cash in this way, or in any case if the profit-sharing committee so agrees, they may issue shares or securities to employees (and to themselves) instead of cash. These shares or securities at the date of purchase or issue, are to be equal in value to the cash, and, again, may be sold by employees if they so desire.

10. Profits for the purpose of this scheme are, broadly speaking, all ordinary commercial profits made by the company, before deduction of income tax. As soon as possible after the end of each year, the company's auditors prepare and hand to the profit-sharing committee a statement showing the amount which in their opinion should go to employees in respect of that year. The committee may, if they think fit, appoint an employees' accountant. If they do so it will be the duty of this accountant to satisfy himself that the annual statement prepared by the auditors is correct. If he fails to agree on any point with the company's auditors, he may consult with the profit-sharing committee, and if necessary, submit the matter to arbitration.

11. If in any year the total salaries of directors exceed the total on December 31, 1922, the committee may ask for information as to the amount of the excess, and if they regard it as unreasonable, after taking into account the amount of the company's business and the duties performed by the directors and so on, they may require the question of the excess to be submitted to arbitration. If any portion of this is disallowed by the arbitrator, it will be deducted from the directors' share of profits under the scheme.

12. The company's contributions to the pension fund, the widows' benefit fund, the unemployment benefit fund and any other similar funds, will be unaffected by the existence of the profit-sharing scheme. Under this scheme they remain a first charge on the profits before anything is paid to capital at all.

13. From the beginning, careful thought has been given to the drawing up of the scheme in such a way as to be entirely fair to the interests of labor. In particular, provisions have been inserted that a lock-out or an authorized strike is not to be considered as a breach of service leading to forfeiture of the right to profits under the scheme. Again, one of the regulations is to the effect that it is the desire of the company that the scheme shall not alter the position of trade unionism at the works, and that it is desirable in the interests of the company and its employees that the latter shall be suitably organized, and that membership of a trade union is, in the general case, desirable. The scheme has been submitted to and approved by the two trade unions covering the great majority of the company's employees.

14. A profit-sharing committee is elected by the central council, and has power to act on behalf of employees in relation to the scheme. In particular it may set aside such part of labor's share of profits in any year as it thinks fit, either for collective purposes or for community purposes. It also has power to determine which employees are eligible to receive payments under the scheme and in respect of what period of time. It may also, in suitable cases, consent to any departure from the regulations.

15. The scheme will continue until terminated at the end of any year by 12 months' previous notice in writing given either by the company or by the central council.

WILLIAM WALLACE.

An Income Tax Problem

IN line with their general policy of maintaining the Reader's Page as an open forum for the discussion of all kinds of topics and problems in management, the editors give space to the following letter of inquiry:

Editors of MANAGEMENT AND ADMINISTRATION:

If I, as an individual, have an income of approximately $16,000 per annum, all of which is taxable for normal or surtax, my federal income tax will be $1180.

I am told that it is possible to set aside $6000 of this income as a separate irrevocable trust, the tax on which would be $10 if the income were dividends only. The taxes on $10,000 would be $520. The sum of the taxes ($520 + $10) would be $530. This amount when deducted from $1180 will leave a saving in taxes of $650.

It is claimed that under such an arrangement the income from these securities could be used, first, for the payment of annual life insurance premiums; then for the expenses of the trust; and the balance could be distributed to the individual himself, his wife, members of his family, or others as directed.

Can any of your readers give me additional information about the establishment of such a trust? Without doubt, this subject has had full consideration from those interested in wills, estates, etc. Is there available a legal form for the establishment of such a trust? I am interested in this matter both as an individual and as an income-tax counselor. I shall appreciate very much any suggestions or information that may be supplied by any of your readers.

EDWARD A. PRATT.

NEWS OF EQUIPMENT
FOR THE MANAGEMENT

Orifice Valve to Control and Measure Steam Flow

Index Number
621.1866 Steam orifices

THE orifice valve shown in the sectional drawing has been developed to meet the demand for a device which will deliver steam at predetermined rates of flow. The maker is the Walworth Manufacturing Company.

The valve consists of four essential parts, the regulator, the receiver, the calibrated orifice, and the indicator. The general arrangement is shown in the illustration.

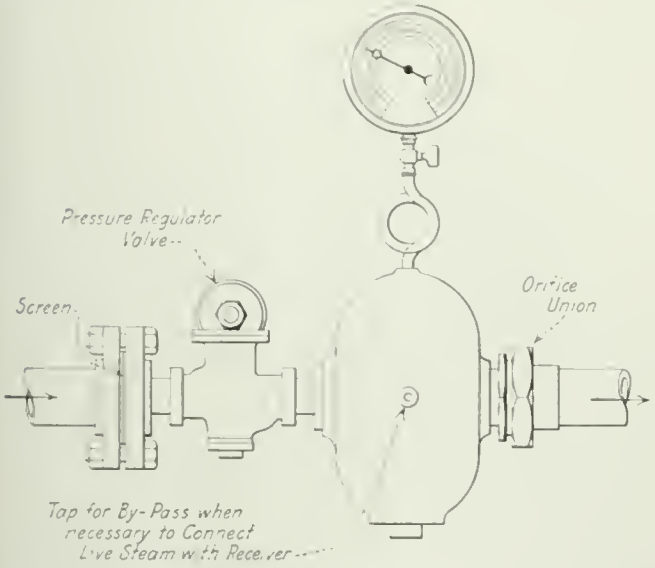

FIG. 1 ARRANGEMENT OF PRESSURE REGULATOR, ORIFICE AND GAGE

When installed the valve has a horizontal position but the union and orifice may be installed either as shown or they may be connected at the bottom of the receiver. The piping arrangement, with a swing joint, permits of the removal and insertion of the orifice. The tap openings on the side of the receiver are used when it is necessary to connect bypasses for live steam to the receiver.

Orifices can be supplied having area in square inches of 0.05, 0.10, 0.20, 0.40, 0.80. The indicator, Fig. 2, an integral part of the device, indicates on the dial the rates of flow obtainable with the several orifice nozzles. The principle on which this instrument is based requires that the absolute pressure on the discharge side of the orifice does not exceed 58 per cent of the absolute receiver pressure. This device was developed primarily to meet the demands of refinery practice and provide a comparatively simple piece of apparatus to measure and control rates of steam flow to stills and similar apparatus.

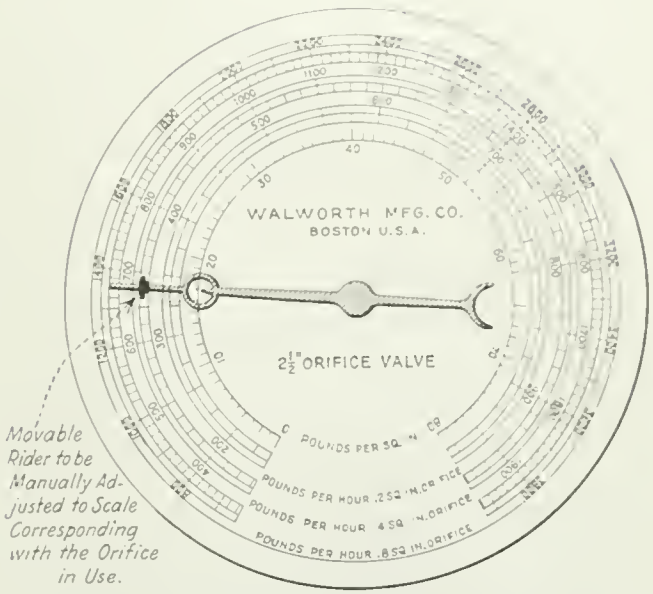
WALWORTH MFG. CO.
BOSTON U.S.A.
2½" ORIFICE VALVE
POUNDS PER SQ. IN. GA
POUNDS PER HOUR .2 SQ. IN. ORIFICE
POUNDS PER HOUR .4 SQ. IN. ORIFICE
POUNDS PER HOUR .8 SQ. IN. ORIFICE
Movable Rider to be Manually Adjusted to Scale Corresponding with the Orifice in Use.

FIG. 2 DIAL OF GAGE READING STEAM FLOW

Automatic Stop and Check Valve

Index Number
621.116 Valves

THE valve shown in Fig. 1 is an automatic stop and check valve with latch control. It can be used with steam, water, gas, air, or oil as the operating medium, and will automatically shut off the flow of fluid through the main valve when the pressure in the control line is released due to shutting down the system or to a rupture in the control medium lines. One specific application is on lines for supplying fuel oil to burners under steam boilers.

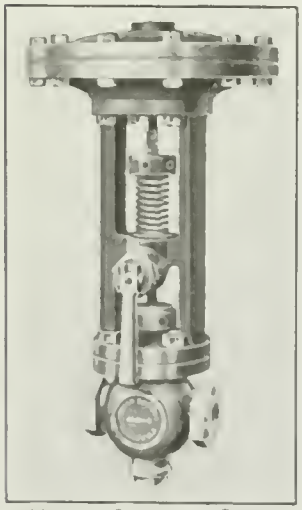

FIG. 1 STOP AND CHECK VALVE

The main valve is held closed against the pressure in the control chamber by means of a latch. When the lever handle is raised this latch is released and the valve is opened by the pressure of the control medium, compressing an adjusting spring. This spring can be regulated to give any desired resistance to the rise of the valve.

If a rupture or shut-off of the control-medium line occurs, the spring forces the valve back on its seat where it locks under the latch. It can be opened again only by operating the lever. Hence, if the control medium is compressed air and the main valve regulates oil flow to burners, a shutting off of the air at once shuts off the fuel oil and prevents flooding of the furnace, with consequent danger of explosion when operations are again started up.

The valves are constructed with diaphragms suitable to the service in question. They will operate in any position, but preferably should be installed vertically on horizontal pipe lines. Sizes range from ½ in. to 2 in. in composition body type with screwed ends, and larger in iron body type with either screwed or flanged ends. The valves are known as Class H-4 and are made by the Foster Engineering Company.

Time-Study Board

Index Number
658.5421 Time study

THE Hough Time-Study Board, manufactured by the Stein and Ellbogen Company, and shown in the illustration, is intended to combine the features needed in such a device for general time-study work.

It provides a convenient writing surface for holding the record blank and holds the time-study watch in position to be operated by the left hand while the left arm supports the board, leaving the right hand free to record the observation. A pocket within the board provides storage space for blank sheets and data. A movable clip permits of fastening the record below or on either side as is most convenient.

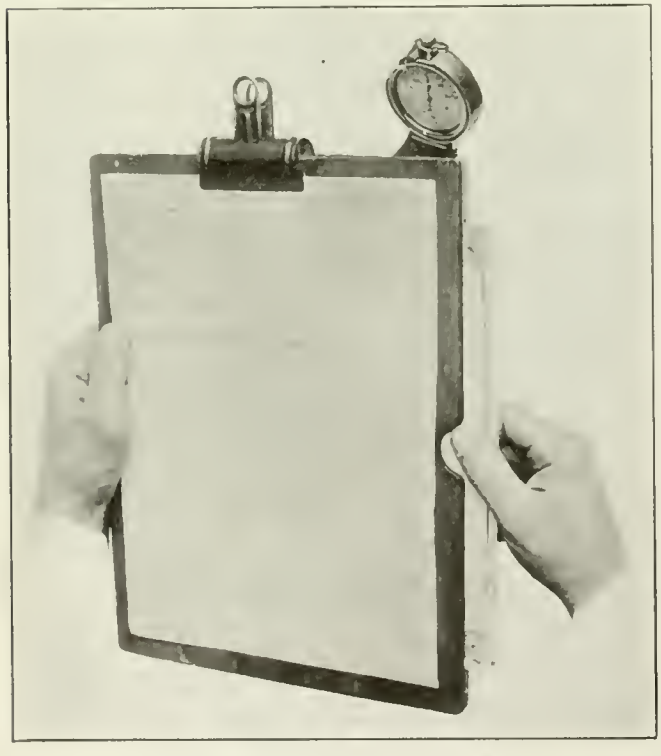

FIG. 1 HOUGH TIME-STUDY BOARD

The watch is held in a locked holder which gives protection against breakage, permits setting the watch at an angle to avoid glare on its face and offers the maximum of visibility when in use. Further, the shape of the watch holder provides a hand grip to assist in holding the board and to increase ease of handling. The woodwork of the board itself is built up to eliminate warping with reasonable treatment when in use.

Duplex Loom Pick Counter

Index Number
677:681.14 Duplex loom counter

TO determine the product of looms measured in picks, and for use in mills working on the two-shift basis, a duplex counter combining two-loom counter mechanisms in one case has been developed by the

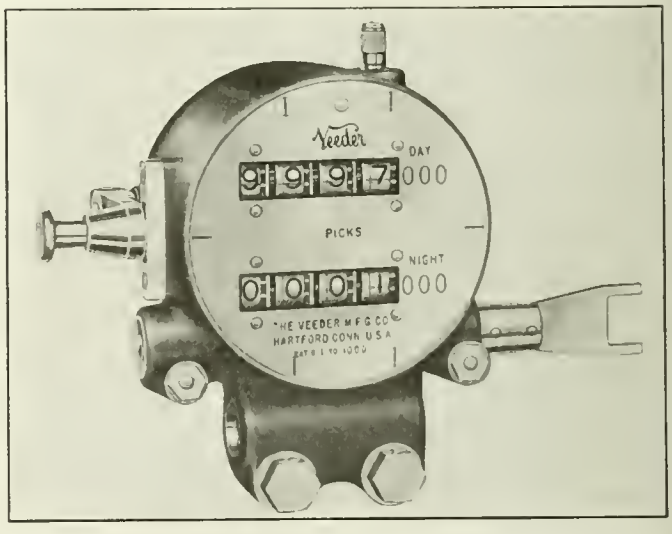

FIG. 1 DUPLEX LOOM PICK COUNTER

Veeder Manufacturing Company. It is generally driven from two holes drilled in the end of the crank shaft, these holes mating with the forked coupling on the right of the instrument. It may be operated from the shafts, however, including the cam shaft or dobby shaft. As usually furnished it registers the output in picks indicating in multiples of 100 or 1000 as desired.

In design this instrument has the features of the standard Veeder loom counter with the advantage of separate recording mechanisms for day and night operations. When the shift changes the incoming operator moves the lever of the counter to an indicated position and registers his own work. Thus there is no connection between the production records of one operator and another.

With this instrument the reading need be taken but once a week, whereas with the single counter it is necessary to read each time there is a change of shift. The instrument shown in the illustration indicates in multiples of 1000 picks. The shift lever has a central or neutral position in which neither counter registers, a convenience when the loom is being repaired, or when for any reason registering is not desired.

Electrical Boiler Water Level Indicator and Recorder

Index Number
621.1875 Feed-water indicator

THIS boiler-room appliance shows the level of the water in a steam boiler. It can be used as an indicator, a recorder, or both. The operating mechanism consists of a set of thermocouples surrounding a brass, or steel, tube of a thickness suited to the working steam pressure of the boiler. A protecting case encloses the thermocouples, and leads are taken off to form the electrical connections to the instruments.

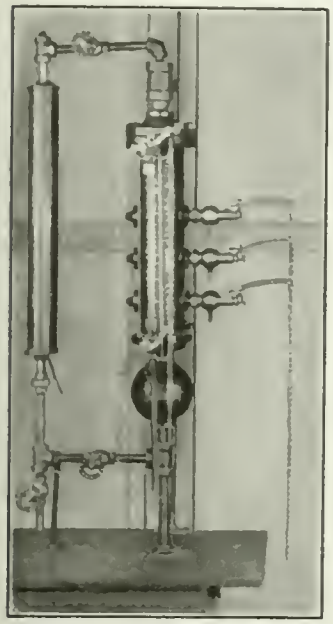

FIG. 1 WATER LEVEL COLUMN FOR ELECTRICAL INDICATORS

The tube on which the thermocouples are built is connected to the boiler in the same manner as a water column, one pipe to the steam space and one well below normal water level. Attachment is made either to the water column as shown in the illustration, or directly to the boiler shell. In either case shut-off valves usually will be installed.

The difference in heat between the steam and water sets up an electric current in the upper thermocouples. As the water level falls, additional thermocouple ends are reached by the heat conducted through the brass tube from the steam, and the current is decreased. This current causes the pointer on the indicator to register high, medium, or low according to the water level in the boiler.

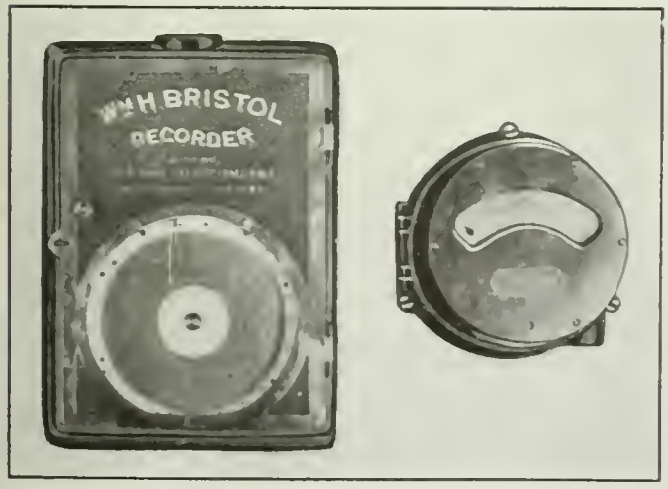

FIG. 2 RECORDING AND INDICATING INSTRUMENTS

If a 24-hr. record is desired, which is particularly helpful in enabling the management to check up on boiler-room operation, a recorder is installed, driven by clockwork. The pen registers the water level continuously throughout the entire day, and the chart becomes permanent data. If a tube blows out it can be determined from the chart whether the cause was carelessness on the part of the fireman in maintaining a correct water level. Should an explosion occur, the recorder will tell whether or not low water level was the primary cause.

If indicating and recording instruments are desired both can be installed. One can be in the boiler-room and the other in the superintendent's office, or any other desirable arrangement is possible. The apparatus, known as the Bristol-Derr boiler water level gage, is made by the Bristol Company.

The U-Fin Air Cooler

Index Number
621.51 Air-cooling

IN power-house practice it has been usual to discharge into the generator room air which has been forced through the windings of electrical generators in order to keep them cool. Not only has the heat in this air been lost, but it has been a source of discomfort to the operating force.

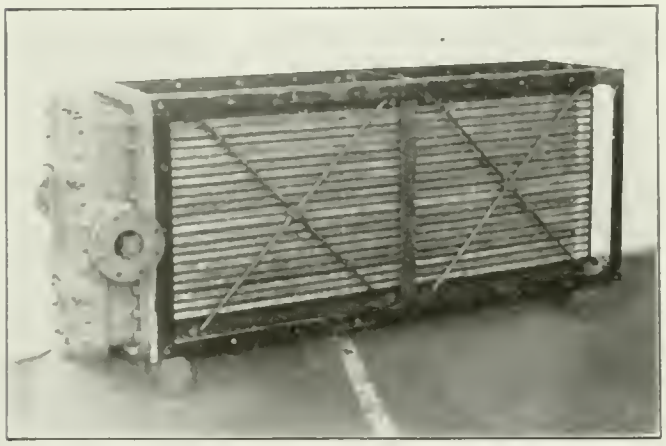

FIG. 1 AIR-COOLER FOR ELECTRICAL GENERATORS

To provide a means of utilizing this heat the U-fin Air Cooler has been designed for installation under the main generator. Its purpose is to cool the ventilating air discharged from the windings. Turbine condensate is the cooling medium and the heat extracted from the air is saved and the temperature of the condensate increased from 8 to 10 deg. fahr., before it reaches the hot well. This cooler is of the surface type and the cooling of the air is accomplished in a closed system permitting the use of the same air over and over again. It is claimed that by its installation the fire hazard in generator windings is reduced, for if a fire should occur it would quickly burn itself out from lack of sufficient air to support combustion.

The cooler is a compact, rigid unit, the sides being encased in sheet iron. The cooling surface is formed of rigid U-fin tubes of $\frac{5}{8}$ in. Admiralty metal with rectangular brass fins.

This device is manufactured by the Griscom-Russell Company.

Pneumatic Riveting Hammer

Index Number
621.544 Pneumatic hammers

THE new type pneumatic riveting hammer shown in the illustration is manufactured by the Ingersoll-Rand Company in three styles designated A, B, and C, and in range of sizes from 5 in. to 9 in. stroke. Each size can be supplied in any one of three types of barrel with either outside or inside trigger handles. Type A has a barrel machined to receive a rivet set clip only and is furnished on orders which do not specify either the bridge type or retainer type barrel.

The features of this riveter are bolted construction for holding the handle to the barrel, combination poppet, and piston type throttle valve, and sensitive control, providing a range from a light tap to a heavy blow. The size specifications are given in the accompanying table.

Size No.	Piston Stroke Inches	Piston Diam. Inches	Length Exclusive of Set, Inches	Length of Standard Piston, Inches	Weight without Set Lbs.	Size Pipe Tap for Hose Connection, Inches	Size Hose Recommended, Inches	Rivet Set Shanks	Weight Packed for Shipment, Lbs	Drives Rivets up to
5A	5	1 1/8	16 1/2	2 1/2	18 1/2	3/8	1/2	1.2165 inch dia. by 2 3/4 in. long	24	3/4 in. dia.
6A	6	1 1/8	17 1/2	2 1/2	19 1/2	3/8	1/2		26	7/8 in. dia.
8A	8	1 1/8	19 1/2	3	22	3/8	1/2		28	1 1/8 in. dia.
9A	9	1 1/8	21 1/2	4	24	3/8	1/2		31	1 1/4 in. dia.

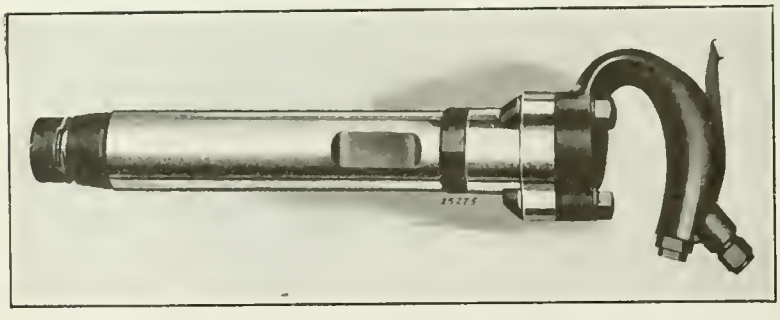

FIG. 1 PNEUMATIC RIVETING HAMMER

Heater for Furnace Air

Index Number
621.182 Boiler efficiency

ANOTHER step in increasing the efficiency of power-plant operation is heating, by means of hot flue gases, the air introduced into the furnace to support combustion. The effect is to reduce the flue-gas heat losses. A heater for this purpose, made by the Combustion Engineering Company, is illustrated on this page. It is of the plate type and consists of a steel casing in which are contained a number of steel plate elements spaced 1 1/4 in. apart. The two plates constituting each element are spaced 1 in. apart. The gas and air are divided into alternate parallel streams which flow in opposite directions, that is, assuming that the gas passes from the lower to the upper part of the heater, then the air will be drawn in at the top and taken out at the bottom. As a result of this method of operation the air encounters an increasing temperature as it progresses through the heater and the temperature difference between flue gas and air is maintained at a practically constant ratio.

In making up a complete heater the required number of elements are assembled side by side and enclosed in a steel casing braced throughout and supplied with flange connection on the inlet and exit gas and air openings. These are for attachment to the air ducts and flues.

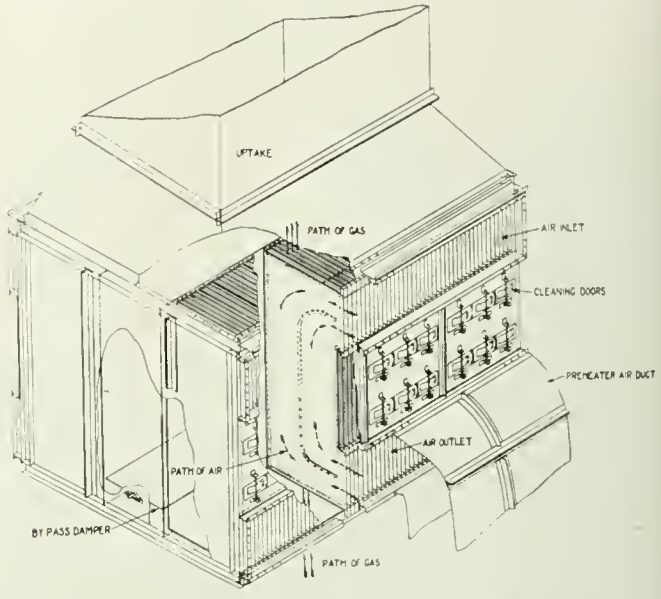

FIG. 1 HEATER FOR BOILER FURNACE AIR

In the Colfax Station of the Duquesne Light Company, a series of tests conducted on a boiler equipped with one of these air heaters showed an average efficiency 6 per cent higher than that obtained from those not so equipped. This increase was accounted for by the increased temperature of the air, and lower combustible in the ash due to improved furnace conditions.

Feeder Group for Pulverized Coal

Index Number
621.18414 Mechanical stokers

FOR burning pulverized coal single and duplex Lopulco feeders have been developed for small boiler units from 300 to 600 rated hp., one motor being used to drive each feeder. A more recent development is a group feeder designed for each boiler unit and consisting of a number of screws arranged in groups of three to ten. In extremely large boilers two or more groups per boiler are provided.

This feeder, which is made by the Combustion Engineering Company, consists of a cast-iron screw of variable pitch revolving in the enclosed casing which forms the bottom of the Hopper. Pulverized coal is fed to this screw by gravity through a hopper frame

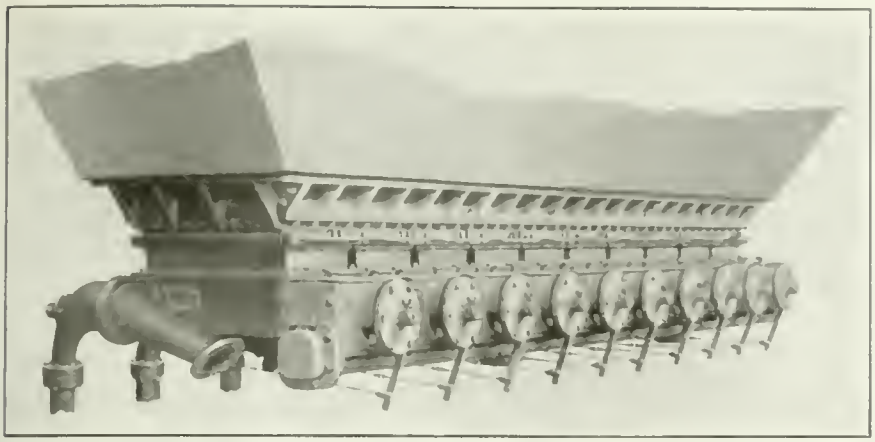

FIG. 1 MULTIPLE FEEDING UNIT FOR PULVERIZED COAL

which is bolted to the bottom of the bin. The screw is motor driven. Fuel is carried to the end of the feeder by means of the screw, where it comes in contact with a stream of air with which it is thoroughly mixed by means of a revolving paddle wheel. The resulting mixture is in the nature of a heavy mechanical vapor which is carried to the burner through a wrought-iron or steel pipe. About 10 per cent of the air required for combustion is introduced as described above.

Locomotive Type Crane

Index Number
621.87 Cranes

THE electric locomotive crane shown below is applicable to the lifting and transporting of heavy parts and packages in manufacturing plants, such as loading and unloading railroad cars, serving castings to machine tools, lifting steel members in erecting shops, picking up and carrying sheet steel and tin plate, and stacking pipe, bar stock, lumber, and the like. It is regularly furnished with a 12-ft. boom, but other lengths can be supplied up to 19 ft. The 19-ft. boom will reach over the top of a locomotive. It will remove the locomotive front door, or stack, hold an air pump in place while it is being bolted up, and when equipped with the auxiliary boom will work under the running board of a locomotive and handle side rods, springs, cross heads, and other parts.

An 8-ft. boom on a 60-in. wheel base is furnished to be used inside a standard box car for loading or unloading heavy packages.

The machine is electrically driven and all controls are mounted on the dash directly in front of the operator. One motor propels the truck, a second slews the crane, and the third drives the main hoist. The latter has two drums driven by a pair of magnetic clutches. A solenoid brake prevents rotation except when power is applied and three limit switches are provided to control each operation.

The capacity of this crane, which is made by the Baker R & L Company, is 3000 lb. at 7 ft. radius with travel speed of 3 to 4 miles per hr.

The battery equipment is 12 cells of 19 plate iron clad or 21 cells of A-18 Edison. The single reduction worm drive axle is driven by a totally enclosed motor equipped with duplex compensating suspension.

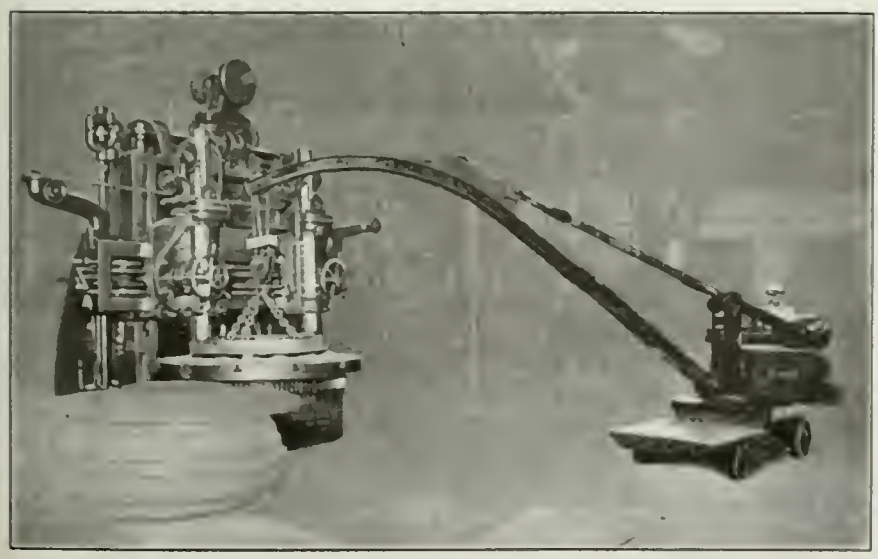

FIG. 1 ELECTRIC LOCOMOTIVE TYPE CRANE

A Stoker Improvement

Index Number
621.18414 Mechanical stokers

TO the Frederick stoker has been added two new features, a secondary ram and tuyere with curved vanes. Both of these devices are shown below.

The secondary ram which feeds and agitates the fuel is composed of tuyeres which form the active fuel-burning surface. The result is greater fuel-burning capacity per retort, and relatively low static air pressure for a given rate of combustion. Combined with these is improved cooling of the secondary ram itself, which is claimed to result in low maintenance and replacement costs.

The feature of the tuyere design is the curved vane which guides the air into the fuel bed and tends to give an even air distribution around the entire tuyere. It also provides a large amount of the cooling surface in the moving air current, which tends to prolong the life of the tuyere casting.

This stoker operates upon the underfeed principle, employing multiple retorts. It is designed and built in both central-station and super-station types to meet the exacting requirements of modern central-station operation.

The new Frederick stoker is built by the Combustion Engineering Company.

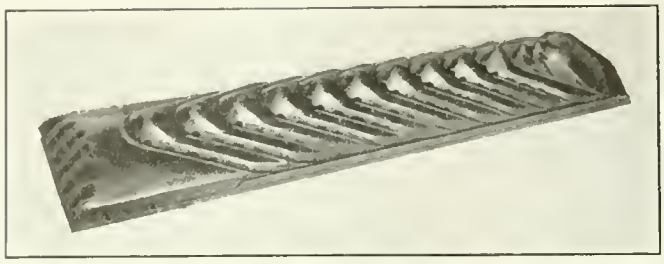

FIG. 1 SECONDARY RAM OF FREDERICK STOKER

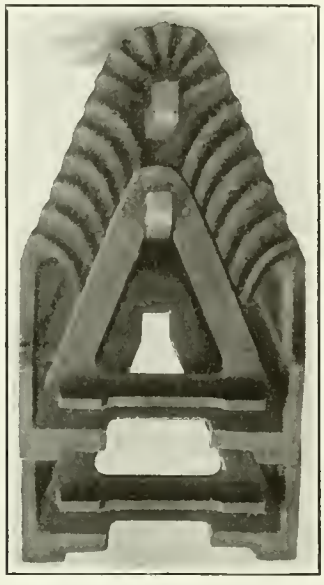

FIG. 2 TUYERE VEINS OF FREDERICK STOKER

Electrical Meters for CO_2 Flue Gas

Index Number
621.1875 Meters for CO_2 flue gas

THE meters shown in the accompanying illustrations — the first, an indicating instrument, the second a recording instrument—utilize a method of gas analysis based on the thermal conductivity of the various gases. In principle, a Wheatstone bridge is used to compare the thermal conductivity of the gas under test with that of another gas adopted as a standard of comparison. The gas to be tested and the gas used as a standard are in small chambers or cells and in each is mounted a small platinum spiral. These spirals are identical. The current from a storage battery controlled by a rheostat divides and passes through these spirals. If the gases surrounding the two gases are alike in thermal conductivity the cooling effects by conduction to the metal cell walls are equal. Consequently the spiral platinum resistances attain the same temperature and the bridge remains balanced. If, however, the gas under test differs from that used as a comparison standard, the bridge is thrown out of balance and the galvanometer deflects according to the magnitude of the unbalancing.

In these instruments, made by the Brown Instrument Company, the cell used for the standard of comparison is filled with air. The other cell is exposed to a flow of flue gas under test. The thermal conductivity of CO_2 differs from air by approximately 40 per cent, while the thermal conductivity of the other constituents of flue gas is substantially the same as air. It is thus possible to calibrate the galvanometer deflections in percentages of CO_2.

When the equipment is put into service and the electric connections are properly made, time should be allowed for the elimination of air from the pipe lines before attempting to check the indications from the meter. The CO_2 meter indications should be carefully checked with an Orsat or other standard test.

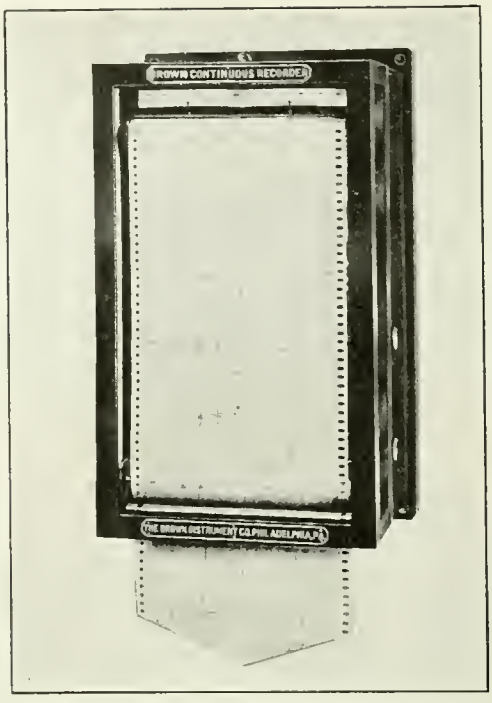

FIG. 1 ELECTRICAL CO_2 RECORDER

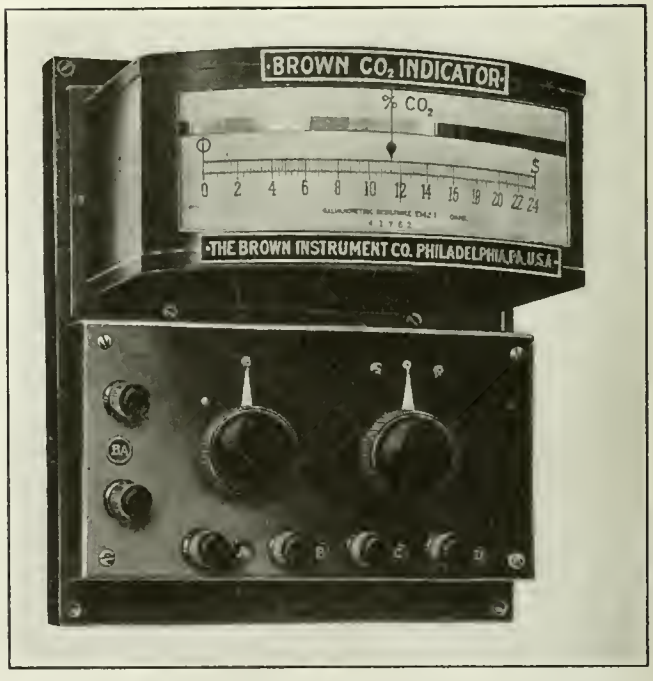

FIG. 2 ELECTRICAL CO_2 INDICATOR

These instruments are intended to be used in industrial operation of furnaces and boiler plants to reduce maintenance attention to the minimum. The duplex recorder of Fig. 1 has two meter elements and registers a double record on one chart. It is possible to record simultaneously CO_2 content and flue gas temperature. Fig. 2 shows the indicating instrument.

Contacting mechanism may also be furnished if desired, to operate signal lights or to connect with automatic control equipment.

CO or Combustible Recorder

Index Number
621.1875 Combustible recorder

THIS instrument can be used either separately or as an adjunct of a CO_2 recorder. The diagram illustrates the separate type. In furnace operation it tells when too little air is being supplied for complete combustion of the fuel being burned under boilers and in furnaces. It helps the fireman supply just the right amount of air at all times in order to reach high efficiency of operation.

Turning to the diagram, *A* and *B* are platinum tubes of small bore, heated electrically, through which the gas sample flows continuously. The gas enters through the inlet *E*, then is passed through the platinum tube *A*. If CO or any other combustible gas is present it will burn within the heated tube *A* and increase the tube's temperature, the increase depending upon the amount of combustible present. The burnt-out gas then flows through the platinum tube *B* and out of the latter under a fixed suction. The hotter the tube *A* becomes the more expanded will be the gas flowing through it, and consequently less gas will enter chamber *C* as tube *A* becomes heated. The outlet suction does not vary, hence a decreasing flow of gas through tube *A* results in a greater partial vacuum in chamber *C*. Thus the varying suction in chamber *C* becomes a measure of the heat units in the gas. By connecting *C* with the recording gage *R*, through a tube *D*, the quantity of the combustible can be recorded in any desired location, as for instance, the engineer's office.

This instrument is a product of the Uehling Instrument Company.

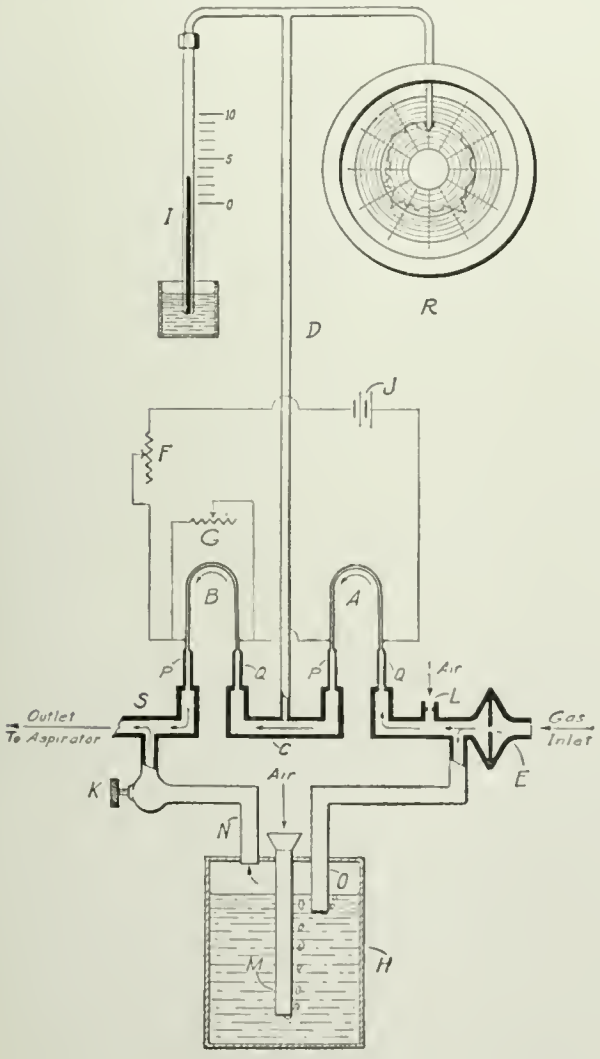

FIG. 1 DIAGRAM OF CO RECORDER

Adjustable Double Race Caster

Index Number
621.812 Adjustable race caster

THE Champion adjustable double race caster for trucks and trailers is shown in cross-section in the illustration below. In construction it consists of a race plate to be attached to the vehicle, the under side of which forms one bearing surface for the balls. Facing this race plate is the housing plate, or fork, in the upper surface of which is a groove for the larger row of steel balls, and near the hub, a cone bearing for the smaller balls. This plate carries the axle of the caster wheel.

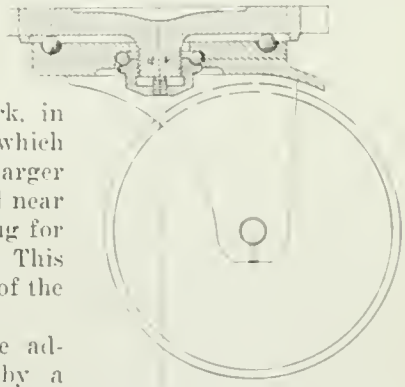

FIG. 1 ADJUSTABLE BEARING TRUCK CASTER

The feature is the adjusting nut locked by a cap-screw in the center of the fork, by means of which, when the smaller ball races become worn, they can be readjusted.

General information in regard to the six sizes in which this caster is made is given in the table below:

No.	Height, In.	Wheel Diameter, In.	Wheel Face In	Plate Sizes	Bolt Holes In.	Weight, Lb., Each
53	5	3	$1\frac{1}{2}$	$4\frac{3}{8}$ x $3\frac{5}{8}$	$3\frac{5}{8}$ x $\frac{7}{8}$	6
64	6	4	$1\frac{1}{2}$	$4\frac{3}{8}$ x $3\frac{5}{8}$	$3\frac{5}{8}$ x $3\frac{5}{8}$	7
75	7	5	2	$6\frac{1}{4}$ x $4\frac{7}{8}$	$4\frac{3}{4}$ x $5\frac{1}{4}$	14
86	8	6	2	$6\frac{1}{4}$ x $4\frac{7}{8}$	$5\frac{3}{8}$ x $5\frac{1}{4}$	16
108	10	8	3	8 x 8	$6\frac{1}{4}$ x $6\frac{1}{4}$	40
129	12	9	3	8 x 8	$6\frac{1}{4}$ x $6\frac{1}{4}$	44

These casters can be fitted with rubber, endwood or cushion tires. They are manufactured by the H. Zering Manufacturing Company.

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 150 magazines and the publications of some 50 book publishers and professional societies. The items are prepared and classified by the Engineering Societies Library in New York City. Photostat copies of any magazine article indexed can be supplied by The Ronald Press Company for a moderate charge. The books and pamphlets indexed can be procured from their respective publishers.

Accounting 657

Arbitration. W. F. Weiss. *Journal of Accountancy*, Nov. 1923. v. 36, 327-335. Relations between the Arbitration Society of America and the American Institute of Accountants, and what possibilities await the accountant in the arbitration field.

657.524

Choosing the Basic Cost Plan. National Association of Cost Accountants. *Official Publications*. Nov. 1, 1923. v. 5, 12 pp. How to choose a *control* accounting system rather than merely a cost system.

657.5:621.72

Cost Control for Foundries.

By F. C. Everitt and Johnson Heywood. 226 pp. McGraw-Hill Book Company, Inc.

Before the authors of this volume get down to the details of costing in foundries, they give a vigorous boost to cost accounting in general. Properly designed cost methods, they submit, can be used: (1) To show possible manufacturing betterments; (2) As a gage of shop efficiency; (3) As a guide in purchasing materials; (4) To control operating expenses; (5) As a guide in handling labor; (6) To determine what the foundry shall produce; (7) To guide the designing department; (8) As a guide in installing new equipment; (9) To help get business in slack times; (10) To set selling prices; (11) For the psychological effect on executives. The book presents a detailed description of the theory, practice, and routine of cost accounting for foundries. The language used is that of the shop. The subject is presented in such a way that the average foundryman, laying no claim to a knowledge of accounting, may understand it clearly. While special attention is given to problems of the gray iron foundry, all the variations in method needed by makers of malleable, steel, and non-ferrous castings are thoroughly covered.

657.524

Departmental and Standard Costs.

By William S. Kemp. 85 pp. National Association of Cost Accountants.

This is possibly the most significant publication yet issued by the National Association of Cost Accountants, and unquestionably one of the most valuable of recent contributions to the literature of business. It is an exposition of a successful method of cost accounting, in actual operation in a nationally known industrial enterprise. In Mr. Kemp's organization the financial department is made the custodian, so to speak, of all the assets of the corporation. It is held responsible not only for a strict accounting of all real and personal property, but also for an accounting of a reasonable income on the total capital with which it has been charged. After listing the various productive departments, the author attacks the problem of overhead accumulation, taking up such items as rent, heat, light, caretaking, machine rentals, department expense, power, and non-productive department expense such as packing, tool, developing, and drafting. There is a valuable section on normal burden rates. The remaining sections deal with factory adjustments, financial ledger control, summarizing and billing, and financial and statistical statements. This comprehensive, clear treatment of the actual workings of a modern cost system should prove of considerable interest to cost men in many lines of business.

657.524

Formulas for Computing Economies of Labor-Saving Equipment. Materials Handling Division of the American Society of Mechanical Engineers, Nov. 1923. Leaflet, 4 pp. Worked out on the consideration that in a comparative accounting, increased production will always carry a higher value than that attached to normal production.

657.5:336.24

Income Tax Procedure—1924.

By Robert H. Montgomery. 1850 pp. The Ronald Press Company.

New features of indexing and arrangement make more easily accessible the important data provided in this manual, which for seven years has been recognized as the standard authority on income tax procedure. The 1924 editor analyzes upwards of 500 new Treasury rulings and many important court decisions handed down during the past year. The author indicates the best method of preparing every item of the income tax returns. He analyzes, interprets, and criticizes rulings and regulations, digests related court decisions, and adds his own direct and helpful comments. The soundness of Mr. Montgomery's judgment has been demonstrated in the past by hundreds of cases in which he has anticipated new rulings, or his opinions have been upheld in court decisions. Where necessary he explains the accounting procedure needed to secure correct values. In addition to current use this volume should be preserved with the preceding issues for future reference. A complete file of the successive editions affords real protection in case some question should be raised in subsequent years on a return.

657.524

Industrial Accounting Statistics and Their Interpretation.

By Stanley G. H. Fitch. National Association of Cost Accountants.

This publication points out the way to answers to these questions: (1) Is the enterprise in better financial condition than it was a year ago? (2) If so, is that favorable condition likely to be continued during the ensuing year? (3) If not, what is the cause, and what the remedy? (4) Has the volume of sales shown a consistent growth? (5) Has the aggregate net profit shown a similar growth or have the costs of selling for increased volume absorbed an undue proportion of gross profits? (6) What was the turnover of inventory, of accounts receivable, of total capital, and can such turnovers be improved? Mr. Fitch also deals with a number of important financial and operating ratios, including ratio of net profit to total capital used; of operating profit to sales; of gross earnings to sales; of costs and expenses to sales; turnover of total capital used; turnover of inventories; turnover of accounts receivable; and working capital ratio.

657.524

Interpreting Operations to the Directors. G. C. Brown. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 593-598. How the cost sheets of a company are closed at the end of the month. Shows the manner in which the summarized results are tabulated and charted for presentation at the monthly directors' meeting.

657.524

Is Our Investment in Cost Accounting Profitable? IV. T. W. Howard. *Factory*, Nov. 1923. v. 31, pp. 605-607. Specification costs and how they compare with job costs. Aims of the two systems with examples from practice. A parallel description will assist in deciding which system is the best for a specific industry.

657.5

Need for Accountants as Receivers and Trustees. John B. Niven. *Journal of Accountancy*, Nov. 1923. v. 36, pp. 321-326. Author believes accountants are best qualified for receivership managers. Proves his theory by reviewing the necessary qualifications and the duties performed by each. Willard P. Barrows is quoted in opposition.

657.524:658

Planning—Its Place in Cost Control. R. W. Darnell. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 605-610. Planning is not considered in its relation to layout, but its bearing on the financial end of the business. Gives records and forms which furnish a splendid foundation for the cost system and make it simply a by-product of the factory system.

657.524

A problem in Joint Costs. National Association of Cost Accountants. *Official Publications*, Oct. 1, 1923. v. 5, 13 pp. Principles involved in, and means of arriving at correct methods of such costs.

657.524

Problems in Industrial Accounting.

By Thomas Henry Sanders. 643 pp. A. W. Shaw Company. Reviewed by John M. Scanlon, Comptroller, The Hess-Bright Manufacturing Company.

This book contains a great deal of information for the young man desiring to become a cost accountant. The first part of it is devoted to the principles of cost accounting, and its chapters are devoted to: "The Work of the Industrial Accountant," "Methods of Cost Accumulation," "Cost Accounting and Production Control," "Material and Labor Costs," "Burden and Standard Costs". A bibliography of general cost literature and a number of forms are also shown. Most of the book, however, is devoted to the presentation of problems which have been collected by the Harvard Bureau of Business Research, from business concerns in which they actually appeared. The problems cover production orders, handling, and recording material, recording and distributing labor and burden, burden problems with specific items of expense, cost systems for representative industries, and executive problems involved in the use of cost data. The solutions to the problems are not given, but in some instances references are made as to where the solutions may be found. It is believed that the book would be much more interesting to the student of cost accounting, if the solutions to the problems had been given.

Advertising 659.1

Advertising Campaigns

By Harry Tipper and George French. 432 pp. D. Van Nostrand Company.

In this volume the business manager of *Automotive Industries* and the general editor of *New Jersey Neighborhood Newspapers, Inc.*, collaborate at the time-honored game of killing two birds with one stone. That is to say, they produce a book designed to appeal to the advertising manager or account executive and at the same time serve as a text for advertising courses in schools of journalism or other educational enterprises. The book is in four chief divisions, headed respectively "Investigating the Product," "Investigating the Market," "Planning the Campaign," and "Operating the Campaign". It attempts to make an adequate analytical survey of the factors that determine the success of any advertising campaign. Considerable attention has been paid to examples drawn from the practice of successful advertisers and the book closes with a detailed account of what the authors consider one of the most successful campaigns of recent years. The volume is well printed, attractively bound, and illustrated by a number of charts, maps, graphs, and reproduced advertisements featuring nationally advertised and marketed products.

659.1

The Advertising Principles of John H. Patterson. Samuel Crowther. *System*, Nov. 1923. v. 44, pp. 587-591, 652. Illus. A collection of ideas valuable to the advertising manager. Patterson's rules are: Few words. No 'ad' is large enough for two ideas. Illustrations. Tell why as well as how; and Strong headings.

659.1

The Open Sesame to Success in Industrial Co-operative Advertising. T. W. Vinson. *Printer's Ink Monthly*, Nov. 15, 1923. v. 125, pp. 169-174. The underlying principle of co-operative advertising is "promoting the use" of a product.

659.1

The Science of Marketing by Mail. Homer J. Buckley. *Forbes*, Nov. 10, 1923. v. 13, pp. 148-150. The advantages of advertising by mail and suggestions for conducting sales promotion campaigns.

Buildings and Equipment 658.2

Design and Maintenance of Factory Buildings. H. Pearman. *Industrial Management* (London), Nov. 1, 1923. v. 10 n.s., pp. 239-241. One of a series of articles intended to cover initial layout, design, construction, and maintenance.

658.2

How We Combined Concrete and Mill Construction. K. D. Hamilton. *Factory*, Nov. 1923. v. 31, pp. 608-610, 638. Covers many phases of building design and equipment as illustrated by the shoe factories of the George E. Keith Co. The important feature of their designs was to obtain a maximum amount of daylight at the interior of the building.

658.2

Modern Maintenance of Plant and Equipment. W. G. Ziegler. *Industrial Management*, Nov. 1923. v. 66, pp. 267-276. Illus. The first of a series of articles on plant maintenance, its buildings and fixed equipment. Roofs, floors, lighting, heating, ventilation and other construction problems are discussed. A maintenance study chart and photographs are used.

658.24

Ten Plans that Cut Lighting Costs. Arthur Williams. *System*, Nov. 1923. v. 44, pp. 573-576. Illus. How to save in electric current and how to plan for the most effective lighting in various kinds of business.

Economics 331

338.97

Can We Beat the Business Cycle? Arthur Bullard. *World's Work*, Dec. 1923. v. 47, pp. 210-216. "The way to beat the Business Cycle is to understand it". Statistics and Graphic Charts are essential to the man who must have a forecast of the future and only by the study of figures and curves can the trend of business be followed.

338.4

German Agricultural Implement Industry and Trade. E. M. Zwickel. Suppl. to U. S. Commerce Reports, Oct. 15, 1923. Trade Information Bulletin No. 153. 25 pp. Many of Germany's munition plants have been converted into plants to manufacture farm implements. This pamphlet shows the expansion of trade and its effect on the sale of American implements in Germany and in countries to which Germany may export her products.

33

The Government in Business. G. E. Roberts. 26 pp. Liberty in business versus government control and ownership. Address before the American Bankers' Association, 1923.

331.81

Hours of Labor in Canada and Other Countries. Dept. of Labor, Canada. *Wages and Hours of Labor Report* No. 5, 1923. 32 pp. An up-to-date pamphlet including late developments in the Ruhr.

658.31811

How to Succeed with the Eight-hour Day. Kent Harrison. *Iron Age*, Nov. 15, 1923. v. 112, pp. 1321-1322. How the change from the 12- to the 8-hr. shift was made in the open-hearth department of the Donner Steel Co.

331

The Importance of Earning a Living. Caroline E. MacGill. *Scribner's Magazine*, Dec. 1923. v. 74, pp. 742-747. A convincing and readable article tracing the changes in women's occupations with the idea of proving that we have created present conditions by our love of luxuries and our refusal to settle down to hard work.

338

Industrial Organization—Development and Prospects.

By John Lee. 119 pp. Prentice-Hall, Inc.

The half-dozen chapters of this book are based upon a series of lectures delivered at Cambridge University in the autumn of 1922, under the auspices of the Board of Economics. In these lectures Mr. Lee attempted to present the various recent developments of industrial organizations throughout the world. Mr. Lee frankly admits that in so far as he ventures to draw conclusions from the mass of information he has assembled, these conclusions are comparative rather than definitive. He does not attempt to build up any theory of industrial organization but summarizes the main tendencies of today, so far as it is possible to summarize them. American readers will naturally be particularly interested in Chapter II, on "Industrial Organization in the United States". On a sort of industrial "magic carpet," the author transports his readers in an instant from the Ford plant at Highland Park to the Filene store in Boston; from Endicott Johnson to Link-Belt; and possibly most miraculous of all, from the *New York Times* to the *New Republic*. While Mr. Lee's book gives evidence of no very definite conviction, it does present a considerable amount of significant material.

337

Influence of the Tariff on Prices. Philip G. Wright. *Journal of the American Bankers' Association*, Nov. 1923. v. 16, pp. 301-303. A discourse on tariff, its effect on prices and domestic and foreign production and distribution. The author's summary opinion is that "in the long run a protective policy is wasteful of human effort".

332.4

Monetary Theory Before Adam Smith.

By Arthur Eli Monroe. 312 pp. Harvard University Press.

This is the twenty-fifth volume in the series of Harvard Economic Studies, published under the direction of the University's Department of Economics. Professor Monroe offers in this volume the first survey in English of early monetary theory, and probably the first adequate account in any language. Extended surveys of the sixteenth, seventeenth, and eighteenth centuries are introduced by two sections, one on ancient and the other on medieval monetary theory. The author discusses such topics as the origin and functions of money; qualities desirable in money; problems of the standard, control and prerogatives of coinage; the coinage system; the value of money (commodity, quantity, fiat, supply and demand, and equilibrium theories); theory of price changes; principles of circulation; velocity of circulation; problems of reform. This is designedly a history of theories rather than one of theorists or their times. It will be valuable as a textbook, because knowledge of the early material on monetary theory is indispensable to adequate appreciation of the work of the later writers. It will also be of value to business men, who are coming more and more to see the important bearing upon their daily work of a clear understanding of the fundamentals of economics.

338.5

Open Price Associations. M. N. Nelson. "University of Illinois Studies in the Social Sciences," June 1922. v. 10, No. 2. An exhaustive study covering 240 pages beginning with definitions and a historical background. Some of the subjects covered are: The Eddy theory; Structural features; the Reporting plan; Advantages and disadvantages connected with open price work; and Open price associations and the public welfare. Special chapters are given to the Iron and Steel and Lumber Industry. There is a bibliography.

338.97

The Pre-War Business Cycle, 1907-1914. W. C. Schluter. "Studies in History, Economics and Public Law," Columbia University, N. Y., 1923. v. 108, No. 1, 189 pp. An inquiry into the causes that produced the business depressions during this period in the U. S.

338.5

Prices and Cost of Living. *Labor Review* (Oct. 1923) of the Bureau of Labor Statistics, U. S. Dept. of Labor. 56 pp. Statistics showing the average retail prices of the principal articles of food from 1913-1923.

331.891

Violence in the Coal Fields. Bituminous Operators' Special Committee. n.d. Pamphlet, 32 pp. A series of news releases summarizing some results of the study of labor conditions in the bituminous coal fields.

382

Who's Who in Foreign Markets—How Uncle Sam Helps Export Managers. Arthur S. Hillyer. *The Credit Monthly*, Nov. 1923. v. 25, p. 28. Tells of information made available to export managers by the U. S. Bureau of Foreign and Domestic Commerce and makes special reference to the Commercial Intelligence Division as a clearing house of foreign sales.

Equipment 658.28

Addressing Machines. Edward T. Fanning. *The Credit Monthly*, Nov. 1923. v. 25, pp. 8, 22, 24. Discusses the many uses of addressing machine.

658.28

What Time Recording Machines Tell. F. E. Francis. *The Credit Monthly*, Nov. 1923. v. 25, pp. 26-27. Relation of time recording devices to office efficiency. Author gives 8 advantages, counting as most important the ability to calculate expense of single operations.

Financial Control. Banking 332.1

Borrowing from Your Bank. S. H. Patterson. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 569-574. Illus. What the bank can, and will do for the business man, and what securities must be furnished to secure financial aid. Suggestions are given for testing the financial condition of a business.

657.524:658

Estimating Monthly Collections of Cash. J. H. Barber. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 581-584. The treasurer can estimate in advance the amount of cash that will be at his disposal if a "Collectibles Fund" is available. This article shows how to build up such a fund.

658.14

Handling the Finances of a Business. Frederick K. Kupprecht. *System*, Dec. 1923. v. 44, pp. 723-727. Planning is the keynote in financing a business, but plans must change as the business changes. A systematic outline given to a bank will strengthen the borrower's arguments.

658.14

Interpreting Operations to the Directors. G. C. Brown. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 593-598. How the cost sheets of a company are closed at the end of the month. Shows the manner in which the summarized results are tabulated and charted for presentation at the monthly directors' meeting.

658.14

Is Our Investment in Cost Accounting Profitable? IV. T. W. Howard. *Factory*, Nov. 1923. v. 31, pp. 605-607. Specification costs and how they compare with job costs. Aims of the two systems with examples from practice. A parallel description will assist in deciding which system is the best for a specific industry.

332.11

Universally Acceptable Checks. Thomas L. Gregg. *The Credit Monthly*, Nov. 1923. v. 25, pp. 14-15, 24. Illus. Describes the old banking method of "interest charge" and "exchange charge" on checks, how this was eliminated by the Federal Reserve Act, and how a par payment system was established.

Industrial Accidents 614.8

Estimated Annual Number and Cost of Industrial Accidents in the United States. Carl Hookstadt. *Monthly Labor Review*, Nov. 1923. v. 17, pp. 991-999 (1-9). An attempt to determine, through statistics, the number and cost of industrial accidents in the U. S. under normal industrial conditions.

614.8

Industrial Accident Experience Tables. J. B. Hackett. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 649-659. The author has brought into convenient form the statistics necessary for an individual plant to judge

its relative standing in number and nature of accidents. An aid in planning for accident prevention.

614.8

Saving Men and Money. Floyd W. Parsons. *World's Work*, Nov. 1923. v. 47, pp. 29-33. A popular discussion of accidents giving some telling figures which prove the cost of carelessness. Advocates more diligence in teaching safety measures.

Industries. Special 658.9:629.113

The Application of Conveyor Equipment to a Small Production Plant. H. P. Harrison. *Society of Automotive Engineers' Journal*, Nov. 1923. v. 13, pp. 357-365. Illus. How conveyors were installed in an automobile plant without interrupting production. Results were accomplished with a minimum amount of rearrangement of the plant and an investment commensurate with the saving effected.

658.9:629.113

Complexity of Production Problems Increasing Each Year. W. L. Craver. *Automotive Industries*, Nov. 1, 1923. v. 49, pp. 872-876. Portraits. Points out the changes from the so-called artisan type of workmanship to mass work as carried by a systematized organization. Directed to the man interested in the mechanical end of the automobile industry.

658.9:681.61

Control Methods Determine Efficiency of Production. Percy S. Brown. *Automotive Industries*, Nov. 1, 1923. v. 49, pp. 893-896. Digest of a paper on the "Prodnction Control Methods of the Corona Typewriter Co." Covers the methods division and time-study work.

658.9:621.72

Cost Comparison in Handling Materials. S. B. Brown. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 611-614. Illus. Shows the economy of mechanical equipment as used at the Warren Foundry & Pipe Co. where it is necessary to have on hand between three and six months' supply of materials in order to avoid shutdowns.

658.9:685.3

How We Combined Concrete and Mill Construction. K. D. Hamilton. *Factory*, Nov. 1923. v. 31, pp. 608-610, 638. Covers many phases of building design and equipment as illustrated by the shoe factories of the George E. Keith Co. The important feature in designs was to obtain a maximum amount of daylight at the interior of the building.

658.9:674

Mechanical Engineer in the Management of Woodworking Industries. W. L. Churchill. *Mechanical Engineering*, Dec. 1923. v. 45, p. 692. The mechanical engineer in this article is really the man who can reduce management to a definite science. It is this kind of organization which is needed in the woodworking industries.

658.9:625.246

Planned Repetitive Manufacture of Heavy Equipment. W. B. Ferguson. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 585-592. Illus. The example selected is 1500 hopper type steel cars made for the C. & O. R.R. by the Newport News Shipbuilding and Dry Dock Co. Does not discuss the mechanics of car building, but brings out the need for careful correct planning.

658.9:621.72

Surprising Profits from Small Savings. C. C. Chesney. *Factory*, Nov. 1923. v. 31, pp. 595-598, 626. Illus. How intensive attention to little things, and a study of motions and costs, brought about improvement in methods and production in the foundry.

629.113:338

Tendencies in the Automobile Industry. C. C. Edmonds. *American Economic Review*, Sept. 1923. v. 13, pp. 422-441. Several representative companies furnish the historical background for this article which examines the industry as to its integration, combination, and monopoly. A section is also given up to "The Parts Industry".

658.9:629.113

Test-tubing the Automobile. Clinton W. Gilbert. *Business*, Nov. 1923. v. 5, pp. 20-21, 54, 56. Illus. Describes tests made by the U. S. Bureau of Standards of special interest to the automobile industry. Special reference to gasoline, brake linings, and tires.

658.9:629.113

What About Automobile Shops? A. L. DeLeeuw and K. D. Condit. *American Machinist*, Nov. 1, 1923. v. 59, pp. 683-684. How to obtain greater efficiency in drilling operations by attention to proper drill grinding, arrangement of drilling spindles, etc. Both operator and machine should be kept constantly busy.

Insurance 658.284

"Covering" What Insurance Can't Cover. R. S. Moulton. *System*, Dec. 1923. v. 44, pp. 741-743, 802. Illus. Describes methods for protecting records against fire.

368.1

Fire Safety as a Credit Item. W. W. Orr. *The Credit Monthly*, Nov. 1923. v. 25, pp. 10-11. How the National Association of Credit Men co-operated with the National Fire Protection Association to bring about greater safety and reduction in insurance rates.

658.284

Protection of Records, Preliminary Report of the Committee on National Fire Protection Association. 1923. Reprint. 5 pp. Gives methods used to protect records against loss by fire.

Management 658

Autocratic Management in Production Does Not Give Best Results. N. G. Shidle. *Automotive Industries*, Nov. 1, 1923. v. 49, pp. 877-878. Title is a misnomer. The article is a cursory report of some of the topics touched upon at the S.A.E. Meeting at Cleveland, Oct. 25 and 26, 1923.

658

Complexity of Production Problems Increasing Each Year. W. L. Craver. *Automotive Industries*, Nov. 1, 1923. v. 49, pp. 872-876. Portraits. Points out the changes which have been made from the so-called artisan type of workmanship to mass work as carried by a systematized organization. Directed to the man interested in the mechanical end of the automobile industry.

658.16

Effect of Plant Location and Machine Grouping on Profitable Operation. D. S. Kimball. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 599-604. Illus. The author describes various methods of machine grouping and pointing out the advantages and disadvantages. This is the fifth article in the series, "The Organization of Modern Industry".

658

The General Question of Extent and Method of Control Under Scientific Management. Charles W. Mixter. *Harvard Business Review*, Oct. 1923. v. 2, pp. 13-22. An analysis of the principles of management. The author believes there is great danger in overdoing the control features and developing a mechanism which is too costly and frequently breaks down.

658(07)

Industry Needs 200,000 Leaders. *Michigan Manufacturer and Financial Record*, Nov. 17, 1923. v. 32, pp. 6, 25. A plea for the training of executives in the engineering field to meet the demands made by the ever-changing conditions in industry. Results culled from reports of Conference organized by the National Industrial Conference Board.

016

Library of Congress as a Source of Business Information. James True. *Printers' Ink Monthly*, Nov. 1923. v. 7, pp. 68, 71. Describes service business men can obtain from Bibliography Division of Library.

658

Managerial Achievement in Human Organization—Can't it be measured? Sam A. Lewisohn. A pamphlet. Guide posts by which the real achievements of management may be measured. Management's primary object is profit, but it must also yield a reasonable development and give satisfaction to the human beings contributing to this profit.

658.16

The Military Type of Organization. W. Maxwell Reed. *Bulletin of Taylor Society*, Aug. 1923. Released Nov. 1923. v. 8, pp. 141-149. A comprehensive article showing how corpora-

tions, through efficient management, may make themselves secure against government ownership. A brief history of industrial organization is followed by a recital of the dangers of the military type of organization. Modifications of its supervisory features are offered.

651.3

Office Organization and Practice.

By Amy Weaver. 144 pp. Ginn and Company.

While the range of this little book is limited, and it does not attempt to compete with the larger and more comprehensive works on office management, it will be welcomed by office managers who are wrestling with the problem of forwarding a program of educational training for their employees. Eight chapters of the book deal with office organization and practice, studying in detail the subject of mail handling, filing, orders, billing, and purchasing. The last four chapters describe the duties of the office executive, including the hiring of new employees, supervision over office routine, and the installation of systems. The author, who is general manager of the Weaver Employment Service, has written this book with the viewpoint of the young employee constantly in mind. The volume shows the way to an efficient performance of various office tasks, making clear their bearing on the business as a whole. It calls attention to the varied opportunities that are offered in the field of office work. Problem and exercise material is provided at the end of each chapter. Much of this material has been drawn from actual cases, and provides a fund of practical information for the young office worker.

658

Overhead Costs in Modern Industry. J. M. Clarke. *Journal of Political Economy*, Oct. 1923. v. 31, pp. 606-636. This very interesting and instructive article is one of a series on overhead costs. It covers the whole field of economic analysis in the *large* plant, touching on machinery and equipment, expansion problems, labor, research, buying, selling, etc.

658

Personal and Business Efficiency.

By C. A. Henderson. 308 pp. George H. Doran Company.

There is much that is new, fresh, and invigorating in this book by Professor Henderson, formerly of the Boston University College of Business Administration and now connected with the Babson Institute at Wellesley Hills. Starting with the handicap of the sadly overworked word "efficiency" in his title, Professor Henderson soon overcomes the handicap and gives his readers a genuinely illuminating exposition of the text, that while business has a tendency to become the kite, flying the man as its tail, the reverse is really the proper order. Business is for life, not life for business. And yet in the meantime business seems to be the larger part of life. The book is very easy to read, and will be all the more helpful by reason of the fact. The author is decidedly broadgage in quoting from other writers. He jumps from Bergson to Hoover and from Emerson to James B. Duke with equal facility. He hooks up Professor Relativity Einstein and Professor John L. Sullivan in the same paragraph. Angels can do no more.

658.02

Platform Speaking—A Practical Study for Business and Professional Men.

By George Rowland Collins. 341 pp. Harper & Brothers.

Skilfulness in platform speaking *pays*. This is the text and the keynote of a book addressed to "the business and professional man, whether he be a college student training for his career, or an established man-of-affairs studying for self-improvement". The author is George Rowland Collins, assistant professor of public speaking in the New York University School of Commerce, Accounts and Finance. While the book is based largely upon actual teaching experience in college classrooms, the material has been so treated that it is of use to the general reader as well as to the college student. There are four main divisions and an appendix. Part I introduces the general study of platform speaking, and concludes with a chapter on "The Control of Nervousness". In Part II, on "The Physical Instruments of Speech," Professor Collins leans rather heavily on "Fundamentals of Speech" by Professor C. H. Woolbert of the University of Illinois. However, the material is good, the debt amply acknowledged, and the readers clearly gainers by the borrowing. Part III concerns "Speech-construction," Part IV, "Specialized Speech-forms," and the Appendix presents a variety of useful material, including suggested subject and outlines for different types of platform speeches.

658.78

The Practical Application of the Theory of Accounting for Supplies. Percy W. Pogson. *Journal of Accountancy*, Dec. 1923. v. 36, pp. 430-439. A plea for better methods of handling supplies and materials. Outlines a plan for a perpetual inventory system.

658

Scientific Management and the Engineering Situation. Sir Wm. Ashley. *Barnett House Papers* No. 7. 1922. 28 pp. A critical analysis of the principles of management as viewed by a British professor. Problem before employers is to combine the creation of new types of labor with consideration for natural human feelings.

658

Surprising Profits from Small Savings. C. C. Chesney. *Factory*, Nov. 1923. v. 31, pp. 595-598, 626. Illus. How intensive attention to little things and a study of motions and costs brought about improvement in methods and production in the foundry.

658

The Things We Learned from Making Over a Business. F. L. Sweetser. *System*, Nov. 1913. v. 44, pp. 577-580, 636. Illus. The reorganization problems of the Dutchess Manufacturing Company covering personnel, manufacturing and selling.

Mechanical Handling 658.281

The Adaptability of the Overhead Conveyor. M. W. Potts. *Industrial Management*, Nov. 1923. v. 66, pp. 292-299. Illus. Hoists—hand, pneumatic and electric, monorails, trolleys, and telphers are all described and clearly defined. Their adaptability and best uses are discussed.

658.281

The Application of Conveyor Equipment to a Small Production Plant. H. P. Harrison. *Society of Automotive Engineers Journal*, Nov. 1923. v. 13, pp. 357-365. Illus. How conveyors were installed in an automobile plant without interrupting production. Results were accomplished with a minimum amount of rearrangement of the plant and an investment commensurate with the saving effected.

658.281

Bread Cooling Conveyor. George F. Zimmer. *Industrial Management* (London), Nov. 1, 1923. v. 10 n.s., pp. 256-258. Illus. A description of the system used in the Atlas Bread Company, Milwaukee. System can be adapted wherever it is necessary to cool, heat, dry or moisten materials under way.

658.281

Cost Comparison in Handling Materials. S. B. Brown. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 611-614. Illus. Shows the economy of mechanical equipment as used at the Warren Foundry & Pipe Company where it is necessary to have on hand between three and six months' supply of materials to avoid shutdowns.

658.28:657

Formulas for Computing Economies of Labor-Saving Equipment. Materials Handling Division of the American Society of Mechanical Engineers. Nov. 1923. Leaflet, 4 pp. Worked out on the consideration that in a comparative accounting, increased production will always carry a higher value than that attached to normal production.

658.281

Getting an 800 Per Cent Increased Haulage at Lower Cost. *Factory*, Nov. 1923. v. 31, pp. 618-619. Illus. Internal transportation system of the B. F. Goodrich Co., operating 40 trains, each train averaging 11 cars. Trains operate almost exclusively through a subway system. Cost of operation and maintenance is distributed monthly to the various departments in proportion to the amount of service they received.

Personnel 658.323

Combining Time Card and Pay Check. E. C. Hough. *Factory*, Nov. 1923. v. 31, p. 601. Company gives the bank a check for the amount of the pay-roll and as each employee rings out on pay day, he lifts his pay check and drops his time card. Blank forms are given.

658.3112

A Comparative Study of Clerical Tests. Part 2. Classifying and Tabulating. L. L. Thurstone. *Public Personnel Studies*, Nov. 15, 1923. v. 1, No. 3. Bureau of Public Personnel Administration Institute for Government Research. Washington. General discussion with 19 examples in classifying and tabulating tests as used by various State Civil Service Commissions. Manifold copy.

658.31112

Co-ordination of Executive Activities. W. W. Kincaid. 1923. *American Management Association*. Pamphlet, 5 pp. Author recognizes the different functions of administration and management, but urges closer co-operation among departmental heads.

658.311511

The German Works Councils. Emil Frankel. *Journal of Political Economy*, Oct. 1923. v. 31, pp. 708-736. A comprehensive article on the struggle among the conflicting social groups in Germany where the Works Councils mean different things. The story of the development of the idea from the time of the armistice to December 1922.

658.3

The Human Element in Production. W. F. Jameson. *Society of Automotive Engineers' Journal*, Nov. 1923. v. 13, pp. 366-369. Points covered are: Importance of right thinking; development of well-balanced brain; inertia the great obstacle; value of auto-suggestion.

658.301

The Liberal Business Man Under Fire. E. A. Filene. *World's Work*, Dec. 1923. pp. 51-57. A readable article which attempts to analyze the attitude of the liberal business man and arrive at some reasons why he faces persistent opposition from his fellows. Closes by offering two suggestions that might clear the road of business and social progress.

658.3185

Making the Employee Publication Really Pay. D. C. Vandercook. *Factory*, Nov. 1923. v. 31, pp. 613-615, 644. Illus. Such a paper must be edited along broad and dignified lines with the management's approval stamped upon it. It should become "a platform where both workers and management can board the same train".

658.3113

Methods of Transfer and Promotion in Business Organizations; Report prepared by the National Association of Corporation Training. 1920. *Reprint*, 1923. Pamphlet issued by American Management Association giving plans in practice. Contains forms for employee records.

658.3

Personnel Management.

By Walter Dill Scott and Robert C. Clothier. 643 pp. A. W. Shaw Company.

The sub-title of this book, "Principles, Practices and Point of View," indicates the purpose of the authors, which is obviously to attack the personal problems of management from every point of the compass simultaneously. The impact of this attack may be judged from the fact that there are nearly 500 pages in the body of the book. The appendix alone has more pages than are used for the entire contents of most of the volumes heretofore produced in the personnel field. President Scott of Northwestern University and Mr. Clothier, formerly employment manager of the Curtis Publishing Company, make a very strong team. With a wealth of experience from which to draw, the authors of "Personnel Management" have taken the foundation principles of personnel administration, stripped them of the vagueness with which they are generally clothed, and discussed them in terms of their practical application to problems of management. This is in every sense a big book. It is one to which managers must give due consideration, for it presents a graphic delineation of a well set-up personnel control applicable, with slight modifications, to practically any type of business organization.

658.3

Production Efficiency Increases by Speeder of Human Element. W. F. Johnson, Eugene Bouton and H. P. Harrison. *Automotive Industries*, Nov. 1, 1923. v. 49, pp. 883-884. Suggestions for instilling into the worker the spirit of working for himself. Develop concentration and so eliminate time for expressions of dissatisfaction. Extracts from paper by W. F. Jameson on "The Human Element in Production".

658.386

Rational Works Management in Factories. IX. Training. John A. Davenport and J. Inman Emery. *Industrial Management* (London), Nov. 15, 1923. v. 10 n.s., pp. 270-272. Advocates the classification of employees according to their capabilities. Bases groups on physical and mental ability and then trains them for special tasks.

658.384

"Save at the Shop". A Ringing Challenge to Workers. Allard Smith. *Bankers' Monthly*, Nov. 1923. v. 40, pp. 28, 58-61. The bank's plan for industrial savings. A description of methods covers: Selling the management, Selling the worker, Installation and operation, and Resolicitation.

658.3112

Selecting Employees. Report of Committee on Employment plans with Convention Discussion. Chairman, Earl B. Morgan, Curtis Publishing Company. 1923. *American Management Association*. Pamphlet, 24 pp. A comprehensive discourse on methods. Covers every step from the reception of prospective employees to the final results of the interview and methods of recording it.

658.331151

Supervision and Discipline. Elisha Lee. *American Management Association*, 1923. Pamphlet, 8 pp. Describes plan of Employee Representation of the Pennsylvania Railroad System. Author claims better acquaintance increases respect between management and employees. Disciplinary cases are taken care of by a fifty-fifty Discipline Committee.

658.316

Unemployment Agreement Between Members of the Chicago Industrial Federation of Clothing Manufacturers and the Amalgamated Clothing Workers of America. Oct. 1923. 30 pp. Pamphlet giving text of the agreement.

658.3112

Value of Physical Examinations in Pulp and Paper Mills. Seth L. Bush. *Paper Trade Journal*, Nov. 8, 1923. v. 77, pp. 24, 37. Such examinations furnish a selection policy by which applicants are placed on the work best fitted to their physical capabilities and limitations. This gives protection and medical aid to the worker, and lessens the accident compensation burden of the company.

658.3185

What the Personnel Publication Can Do for the Worker. D. C. Vandercook. *Industrial Management*, Nov. 1923. v. 66, pp. 307-310. Discusses how the plant or personnel publication can be made really valuable to worker and company. Effective paragraphs selected from a number of papers are given.

658.3

Why Our Labor Costs Are Low. F. L. Sweetser. *System*, Dec. 1923. v. 44, pp. 733-736, 785. Illus. Personnel principles as worked out by the Dutchess Manufacturing Co. Advocates the Committee System and includes some points on training of employees.

658.31158

Workable Employee Suggestion System. L. W. Tomlin. *Iron Age*, Nov. 15, 1923. v. 112, pp. 1315-1316. System of the Remy Electric Co., Anderson, Ind. A definite time is allotted for a suggestion campaign during each year. Rewards, from $5.00 to $250.00, are paid for workable suggestions.

331

The Worker in Modern Economic Society.

By Paul H. Douglas, Curtice N. Hitchcock and Willard E. Atkins. 920 pp. The University of Chicago Press.

This is another volume in the series, "Materials for the Study of Business," issuing from the press of the University of Chicago. It is designed for use as a textbook but, like many books recently published, has a distinct and valuable message for the man whose training is being secured on the job rather than in college classrooms. From the ordinary text on labor problems this volume differs in two important respects. First, it aims to widen its scope by emphasizing both the psychological and the underlying industrial aspects of the modern labor situation, while knitting together the various problems into a more or less unified and organic whole. Second, it is a book of readings, with selections from different sources, rather than a rewriting of them. Both depth and breadth are evident in the authors' examination of the psychological and the historical backgrounds of labor, their analysis of the worker's position in industrial America today, and their investigation of the methods and policies which are being proposed and adopted by various groups in industry to meet the conditions in which they find themselves One factor which increases the usefulness of this book to the business executive is its presentation, in convenient form, of considerable source material bearing on controversial issues.

658.3186

Worth-while Vocational Training. George B. Frazer. *Machinery,* Dec. 1923. v. 30, pp. 289-293. Illus. An outline of the program followed by the Vocational School in Grand Rapids, Mich., in training future machinists and mechanical draftsmen.

658.31246

Employee Ownership.

Employee Stock-Ownership Plans; Report prepared by National Association of Corporation Training in 1921. 108 pp. Pamphlet reprinted by American Management Association, giving outlines of plans, list of companies operating them and the blanks and forms used.

658.31246

Report on Employee Stock-Ownership Plans; Pamphlet by Metropolitan Life Insurance Co., Aug. 1923. 15 pp. Comments on the installation, administration and general results of plans and the complete plans of three companies. Has comparative chart of 36 plans.

658.31246

General Motors Has Plan to Hold Its Key Men. *Printers' Ink,* Nov. 15, 1923. v. 125, pp. 33-36. A plan calculated to supply an incentive to managers by organizing a Managers Securities Company. Managers, or key men in the industry, may be attracted into partnership with the stockholders, by becoming stockholders themselves.

658.3(06)

Labor Associations.

Employees' Mutual Benefit Associations. Bloomfield & Bloomfield. 1922. 19 pp. "The present survey has 'taken stock' of the activities of employee mutual benefit associations throughout the country. A large number of successful plans have been analyzed and their various functions, methods and details compared." Contains 9 analytical charts.

658.3188(007)

Unemployment Agreement Between Members of the Chicago Industrial Federation of Clothing Manufacturers and the Amalgamated Clothing Workers of America. Oct. 1923. 30 pp. Pamphlet giving text of the agreement.

334.7

Employees' Mutual Benefit Associations. Bloomfield & Bloomfield. 1922. 19 pp. "The present survey has 'taken stock' of the activities of employee mutual benefit associations throughout the country. A large number of successful plans have been analyzed and their various functions, methods and details compared." Contains 9 analytical charts.

Power 658.25

The Control of Power Production. III: The Principles of Steam Engine Operation. C. L. Hubbard. *Factory,* Nov. 1923. v. 31, pp. 602-604. Illus. Details of construction which the owner of a plant should know to get the full mechanical efficiency of his engines. High pressures are conducive to economy.

658.26

Fitting the Electric Motor to the Pump. R. H. Rogers. *Water Works,* Nov. 14, 1923. v. 60, pp. 1013-1018. Illus. Discussion on the application of electric drive to a fundamental operation in industrial plants. Takes up the following topics: Ratio of dynamic head to static head; Pump characteristics; Operating off rating; Choice of pumps; and Pump control.

658.26

How $250,000 Was Saved Per Year in Boiler-Plant Operation. Donald Spackman. *Power,* Nov. 13, 1923. v. 58, pp. 785-786. Review of a paper by Mr. Spackman of the Lukens Steel Co. in which plant the saving was accomplished. The paper is discussed by E. M. Gilbert.

658.26

Power Problems of Vital Interest to Executives. J. T. Beard. *Industrial Management,* Nov. 1923. v. 66, pp. 302-307. Illus. How repairs may be kept to a minimum through intelligent supervision and handling of equipment. Steam turbines, steam engine-driven compressors, piping systems and other special machinery are discussed.

Production 658.5162

Comparative Production Studies Suggested to Increase Efficiency. A. L. Evans: *Automotive Industries,* Nov. 1, 1923. v. 49, pp. 896-898. Standardization of machine tool equipment. An attempt to answer the question: "How can machine tools be so designed and built that the user will have the advantage of a machine of proved excellence and low cost, without losing the advantage of special adaptability and economy which the special machine will give?"

658.5

Co-operation Between Shop and Engineering Departments. D. D. Wells. *Machinery,* Dec. 1923. v. 30, p. 270. Comments, supplementary to article in June *Machinery* on "Co-operation of Engineer & Designer", covering co-operation in development of design, co-operation in planning production, and methods employed in the toolroom.

658.58

Determining the Economical Interval Between Cleanings of Condenser Tubes. C. E. Colborn. *Power,* Nov. 20, 1923. v. 58, pp. 803-805. How to calculate the cost of cleaning, the daily cost of the loss due to operating with a given reduction in vacuum, and the daily average reduction in vacuum due to the fouling of the tubes. Includes graphic charts.

658.56

Effect of Plant Location and Machine Grouping on Profitable Operation. D. S. Kimball. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 599-604. Illus. The author describes various methods of machine arrangement, pointing out advantages and disadvantages. This is the fifth article in the series, "The Organization of Modern Industry".

658.51

Efficiency in the Engineering Department. Warren P. Willet. *American Machinist,* Nov. 8, 1923. v. 59, p. 706. Illus. A schedule board keeps the chief engineer informed of the status of his work and shows the worker what to do next.

658.53

Graphic Desk Book that Simplifies Management Problems. Rudolf von Huhn. *Printers' Ink Monthly,* Nov. 1923. v. 7, pp. 56, 59. Continuation of article in October issue on graphic control. Describes charts 7 to 10: Inventory, Monthly sales versus collection, Sales manager and statistician, and Estimating monthly sales on basis of unfilled orders.

658.562

How We Have 14 Per Cent Less Spoilage. F. A. Potter. *Factory,* Nov. 1923. v. 31, pp. 615, 648. Illus. An "Efficiency Squad" is made up of 20 girls chosen from various departments of the Westinghouse Lamp Company. These are trained in all branches of the factory work and become instruc-

tors or supervisors of the less experienced workers. Records show that this supervision reduces spoilage and increases output.

658.56

Idle Capital in the Machine Shop. A. Easthope. *Industrial Management* (London), Nov. 15, 1923. v. 10 n.s., pp. 272-275. Author believes high wages and short hours are not possible without total elimination of capital waste. Emphasizes need of three-shift day, dropping of unproductive organization officials, and complex stores systems.

658.56

Idle Capital in the Machine Shop. A. Easthope. *Industrial Management* (London), Nov. 1, 1923. v. 10 n.s., pp. 244-245. Factors to which machine loss is attributable, and how to remedy this interruption in factory work.

658.51

Planned Repetitive Manufacture of Heavy Equipment. W. B. Ferguson. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 585-592. Illus. The example selected is 1500 hopper type steel cars made for the C. & O. R.R. by the Newport News shipbuilding and Dry Dock Co. Does not discuss the mechanics of car building, but brings out the need for careful, correct planning.

658.51

Planning—Its Place in Cost Control. R. W. Darnell. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 605-610. Planning is not considered in its relation to layout, but in its bearing on the financial end of the business. Gives records and forms which furnish a splendid foundation for the cost system and make it simply a by-product of the factory system.

658.575

Planning for the Manufacture of New Products. W. Wilson. *Industrial Management*, Nov. 15, 1923. v. 10 n.s., pp. 270-272. Treats of the problems involved, especially the making and testing of the model, and modifications that follow.

658.53

Posting and Using the "Tell-Tale" Control Board. C. B. Lord. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 617-621. The author considers three things necessary to the solution of Production Control: Definite budgeting, periodic fabrication and 100 per cent visualization of conditions. Through special tables he shows how the "Tell-Tale" control board operates.

658.581

Power Problems of Vital Interest to Executives. J. T. Beard. *Industrial Management*, Nov. 1923. v. 66, pp. 302-307. Illus. How repair may be kept to a minimum through intelligent supervision and handling of equipment. Steam turbines, steam engine-driven compressors, piping systems and other special machinery are discussed.

658.5

Purchasing Agent and Engineer. W. E. Irish. In Bulletin of Taylor Society, Aug. 1923; released Nov. 1923. v. 8, pp. 150-160. A rather exhaustive article, with Discussion, pointing out results which will help toward a closer alliance between the purchasing agent and his "right-hand man," the engineer. Emphasize the importance to the company of the outside contacts of these two department heads.

658.513

Scheduling and Progress Recording of Drawings. Irwin Hoffman. *Machinery*, Dec. 1923. v. 30, pp. 296-298. Illus. Describes a system for scheduling drawings based on graphical forms.

658.53

The Semi-Logarithmic Chart. A. C. Haskell. *Industrial Management*, Nov. 1923. v. 66, pp. 300-301. Illus. How the logarithmic scale may be used for graphic charts in statistical work.

658.516

Simplification Does Pay. E. M. Rogert. *Factory*, Nov. 1923. v. 31, pp. 598-601. Illus. Basis for arriving at simplified lines was the sales records for the past 3 years. Cost studies led to elimination of waste and simplification and standardization of methods and products.

658.5

The Vertical Combination and How It Reduces Distribution Costs. W. R. Basset & Johnson Heywood. *Industrial Management*, Nov. 1923. v. 66, pp. 279-280. Illus. A "vertical combination" can cover all operations from the source of raw material to the final distribution of the finished product. The article outlines the possibilities of such combinations and illustrates by graphic chart a "vertical combination" in the textile industry.

658.581

What About Automobile Shops? A. L. DeLeeuw and K. D. Condit. *American Machinist*, Nov. 1, 1923. v. 59, pp. 683-684. How to obtain greater efficiency in drilling operations by attention to proper drill grinding, arrangement of drilling spindles, etc. Both operator and machine should be kept constantly busy.

658.581

What the Lubrication Engineer Has Done for Power Plant Maintenance. A. F. Brewer. *Industrial Management*, Nov. 1923. v. 66, pp. 281-289. Illus. Treats of scientific lubrication and its value in machine maintenance. The lubrication engineer should be expert in his knowledge of lubricants and their special value and application. Discusses special machines and their lubrication problems.

658.51

A Workable Planning System for the Moderate-Sized Plant. A. F. Erickson. *Factory*, Nov. 1923. v. 31, pp. 611-612. Illus. Control of all work in process is centered in the planning department, having charge of a planning board which is the basis of the system.

Selling.

Sales Promotion. 658.85

Compensation Plans that Pay Salesmen to Carry Out the Firm's Policies. J. J. Witherspoon. *Printers' Ink Monthly*, Nov. 1923. v. 7, pp. 19-20, 92, 95-96. A recital of plans and an analysis of important features which must be considered in working out a compensation system.

658.8

Creative Salesmanship.

By Herbert W. Hess. 339 pp. J. B. Lippincott Company.

In many respects this is an unusual book, as is doubtless the intention of its author, who is professor of commerce in the Wharton School of Finance, University of Pennsylvania. The sub-title is "Scientific Ideas for Salesmen, Salesmanagers and Sales Administrators," and the front cover presents a Swastika effect in which figure the words "Good Will," "Fulfilment," "Sale Profits," "Urge," "Wish," "Desire," "Personality," "Inertia," and "Will." Professor Hess starts out with the somewhat ambitious thesis that "Future history will come to talk of masters of distribution as the past has emphasized masters of production." That is, of course, something that time alone can reveal, but it is safe to say that the masters of production are not likely to fade completely from the picture. About one-third of the book is concerned with personality building for salesmanship, with strong accent on the training and control of the body. The rest centers around the philosophy of salesmanship, concluding with a discussion of the sales manager and his technic, and chapters on the selecting and the training of salesmen.

658.85

Determining the Salesman's Efficiency. H. G. Kenagy. *Printers' Ink Monthly*, Nov. 1923. v. 7, pp. 42-44. Discusses ways of arriving at a dependable quota and efficiency ratings for salesmen. Gives graphic rating scale.

658.88

Estimating Monthly Collections of Cash. J. H. Barber. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, 581-584. The treasurer can estimate in advance the amount of cash that will be at his disposal if a "Collectibles Fund" is available. This article shows how such a fund can be built up.

658.807

"Everybody in My Territory Has One". A. L. McCarthy. *Sales Management*, Nov. 1923. v. 6, pp. 141-142, 232. The Eureka Vacuum Cleaner Co. use charts and pictures in training their

salesmen. This method stimulates imagination and serves to visualize the growth and methods of the business.

658.808

How International Harvester is Making Sales in Off-Season. Roger Davis. *Printers' Ink Monthly,* Nov. 15, 1923. v. 125, pp. 100-101. This company proves the needlessness of off-season sales slumps by a successful after harvest sales contest of the "might-be-seasonal" cream separator.

658.8

How a Sales Manager Can Make Himself More Valuable to the Business. A. D. Joyce. *Sales Management,* Nov. 1923. v. 6, pp. 133-134, 160. Article is based on the experiences of Mr. Joyce who believes in a flexible organization which is made to fit the men rather than one asking the men to follow a rigid plan. Will interest the sales manager.

658.807

How to Make Salesmen Enthusiastic About the Product. J. A. Murphy. *Printers' Ink Monthly,* Nov. 1923. v. 7, pp. 33-34. Believes cub training more worth while than hiring stars. Describes how Bowker Chemical Company's experimental farm trains salesmen.

658.8

How We Found a Better Way to Pay Our Salesmen. E. V. Waldvogel. *Sales Management,* Nov. 1923. v. 6, pp. 127-128, 193. Company changed from a straight salary basis to salary and commission. Now salesmen are paid a commission for sales made in excess of the base amount.

658.807

Preparing the Cub Salesmen to Handle the Tough Prospects. S. C. Lambert. *Printers' Ink Monthly,* Nov. 15, 1923. v. 125, pp. 25-27. A sales manager's instructions to his salesmen lays emphasis on self-control. Significant paragraphs are quoted from instruction bulletins.

658.817

Simplifying Salesmen's Report Under Complicated Sales System. Arthur Lazarus. *Printers' Ink Monthly,* Nov. 1923. v. 7, pp. 60, 63-64. Sales accounting system controlled by one general office, but district offices, geographically chosen, are responsible for all sales within their territory. Lowe Brothers (paints and varnishes) claim great efficiency and economy for system.

658.808

The Tie-up of Sales and Production. L. J. Conger. In Bulletin of Taylor Society, Aug. 1923: released Nov. 1923. v. 8, pp. 137-140. The carefully prepared article emphasizes the need of sales analysis. The author shows how sales analysis led the Corona Typewriter Co. to estimate its sales possibilities from the circulation of the *Saturday Evening Post.*

658.82

Trade Promotion.

Armstrong Linoleum Field Work that Promotes Sales. A. K. Barnes. *Printers' Ink Monthly,* Nov. 15, 1923. v. 125, pp. 8-12. Author believes the sales promotion man should be the field man blazing the trail for the product he represents, thus serving both sales and advertising.

658.82

Building Sales from Consumer Inquiries. C. B. Larrabee. *Printers' Ink Monthly,* Nov. 1923. v. 7, pp. 26-28, 122, 125. Methods for "follow up" of consumer inquiries. Gives plans used by different types of manufacturing concerns.

658.82

An Experiment in Distribution. John E. Otterson. *System,* Nov. 1923. v. 44, pp. 567-573, 616, 618. Illus. How the "Winchester stores" system came into being. Based on the principle that the manufacturer must create his own demand, the company built up an identity of interests among the manufacturer, the distributor and the dealer. Describes also the organization and purpose of the "Winchester Clubs".

658.82

Five New Accounts Per Salesman. Roland Cole. *Sales Management,* Nov. 1923. v. 6, pp. 161-162, 213. Presents three plans followed by the National Biscuit Company to increase sales, and tells how these may be used with equal effectiveness by smaller organizations.

658.82

Follow-up Methods that Bring the Reply You Want. John C. Sweeney. *Printers' Ink Monthly,* Nov. 1, 1923. v. 125, pp. 53-54, 56. Methods used to get a radical increase in sales within a very limited time. Good speed-up suggestions.

658.82

Gerrymandering a Territory to Promote Sales. Hartwell Chandler. *Printers' Ink Monthly,* Nov. 1923. v. 7, p. 52-55. Sales methods of the Scholl Manufacturing Co. They make foot appliances, and their problem is to train the salesmen and the dealers to push what is considered a sideline. Concentrating within a limited territory gives opportunity for intensive work.

658.82

Getting Real Help from the Wholesaler. Frank L. Scott. *Printers' Ink Monthly,* Nov. 8, 1923. v. 125, pp. 25-28. The manufacturer should help the jobber not only with the sales of his own product, but should co-operate in furthering the sales of all goods carried by him.

658.82

How Mailings Stabilize Our Production. Louis Adler. *System,* Dec. 1923. v. 44, pp. 750-751, 820. Photographs, instead of samples, are used as an advertising medium. Personal letters, followed by circular letters, keep customers up to date on the lines offered by a house where demands are seasonal.

658.82

Making Extra Dividends Possible with Trucks. Charles F. Wark. *System,* Nov. 1923, v. 44, pp. 603-605, 686. How the Pilgrim Steam Laundry Company increased its business by coaching motor drivers also to become salesmen. Drivers are paid a commission on total business delivered, and bonus on new customers secured.

658.82

The Science of Marketing by Mail. Homer J. Buckley. *Forbes,* Nov. 10, 1923. v. 13, pp. 148-150. The advantages of advertising by mail and suggestions for conducting sales promotion campaigns.

658.82

What is a Good Trial Market? Roy Dickinson. *Printers' Ink Monthly,* Nov. 15, 1923. v. 125, pp. 17-19. Illus. How the Beardley's Shredded Codfish made trial advertising surveys and selected five cities to serve as a cross-section trade market to launch a three-year advertising campaign.

658.82

When the Need Arises to Beat the Previously Set Sales Quota. Frank L. Scott. *Printers' Ink Monthly,* Nov. 22, 1923. v. 125, pp. 3-4, 6, 182. If follow-up methods are to become successful we must watch our step, watch our copy and set our sails to the winds of changing conditions.

Shipping 658.785

How Distribution Costs Can be Lowered Through Warehousing. James True. *Printers' Ink Monthly,* Nov. 8, 1923. v. 125, pp. 113-116. Tells of three classes of advertisers who are taking advantage of warehouses to help solve their problems of distribution.

658.6884

Solving the Shipping Container Problem. B. L. Huestis. MANAGEMENT AND ADMINISTRATION, Nov. 1923. v. 6, pp. 575-580. Illus. Contains figures showing tremendous losses due to poor packing. Calls attention to faults in crate construction. Gives methods, including vibration methods, for testing boxes and crates.

Technical 621.86

The Adaptability of the Overhead Conveyor. M. W. Potts. *Industrial Management,* Nov. 1923. v. 66, pp. 292-299. Illus. Hoists—hand, pneumatic and electric, monorails, trolleys, and telphers are all described and clearly defined. Their adaptability and best uses are discussed.

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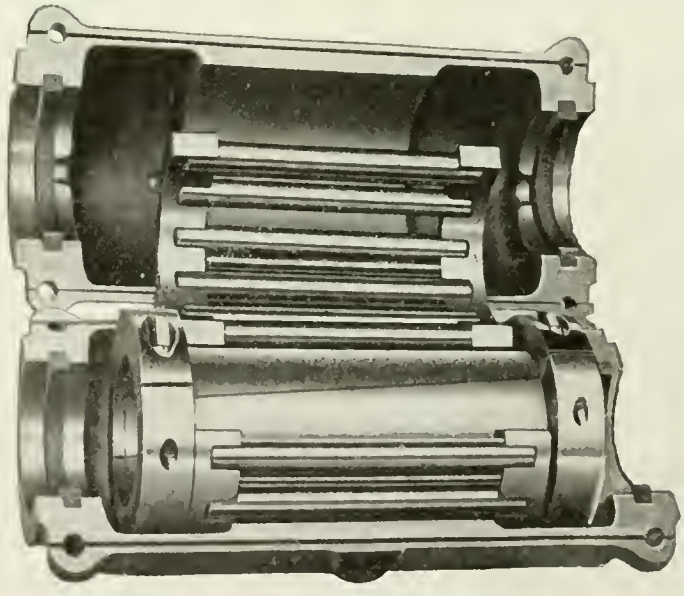

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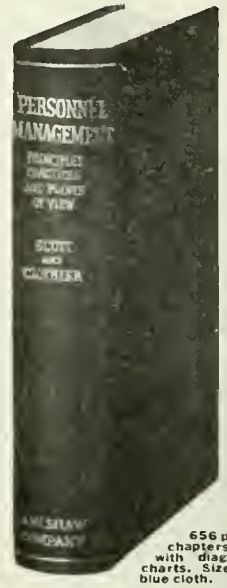

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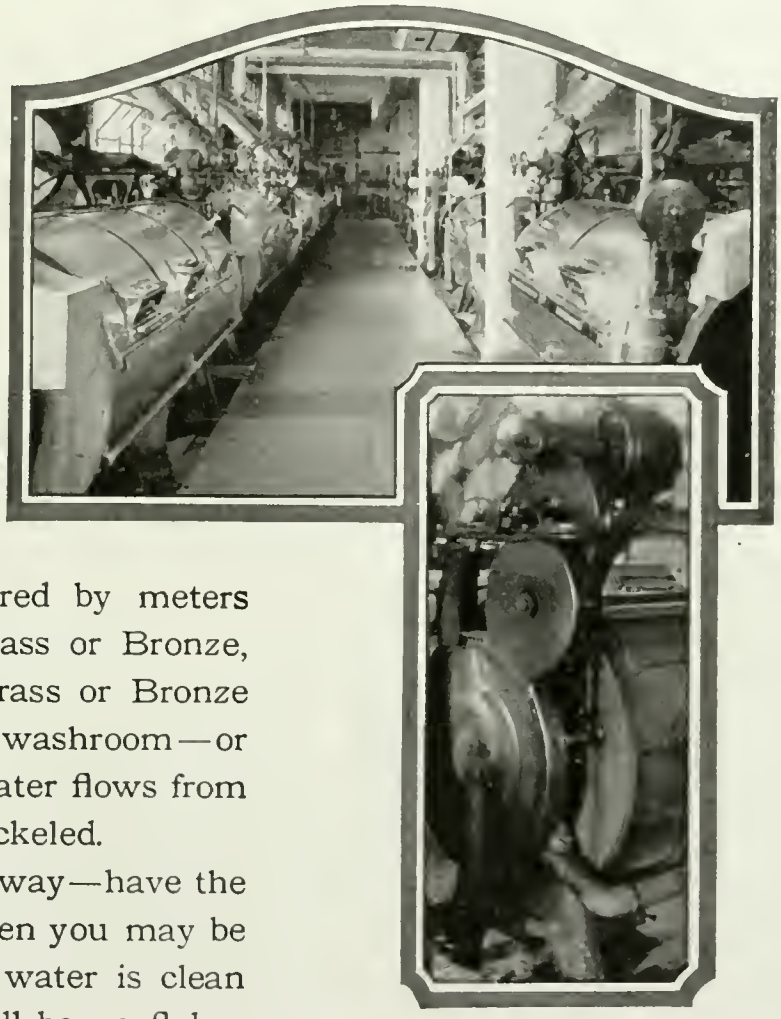

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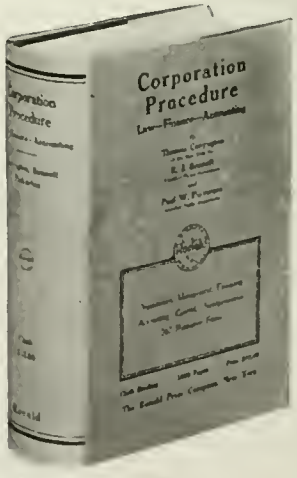

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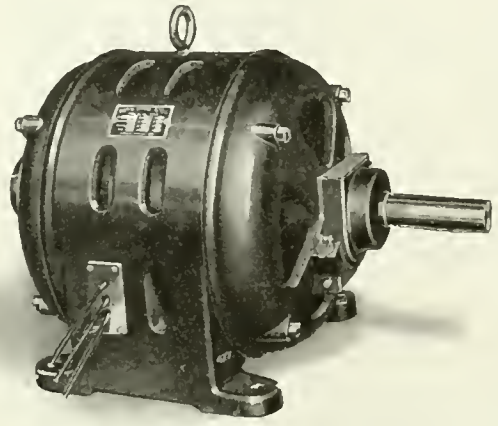

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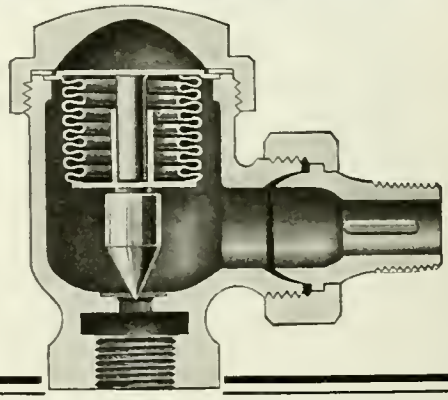

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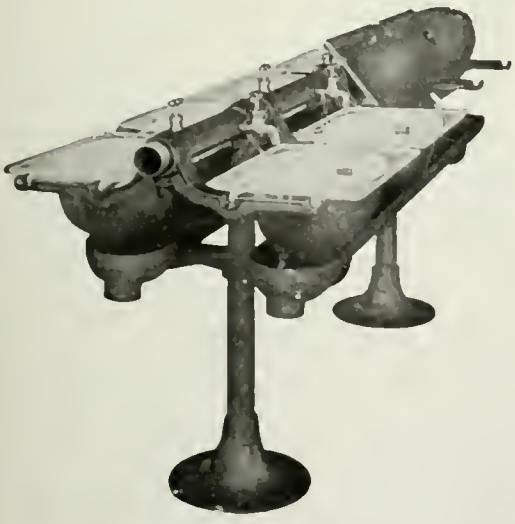

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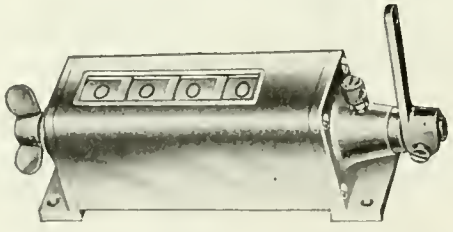

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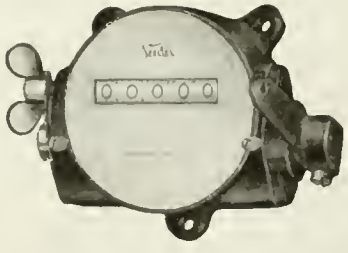

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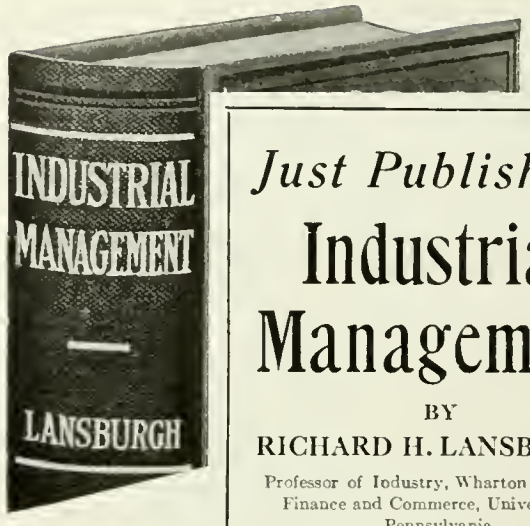

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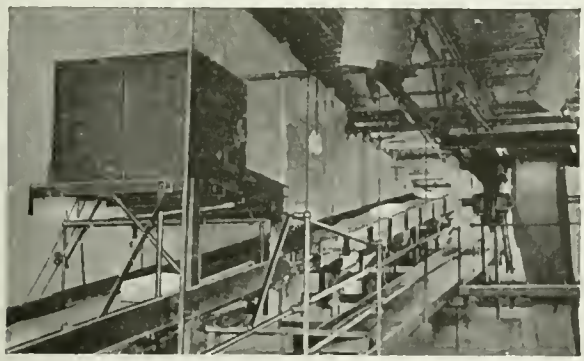

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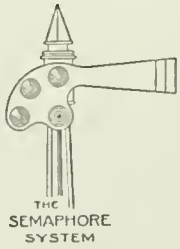

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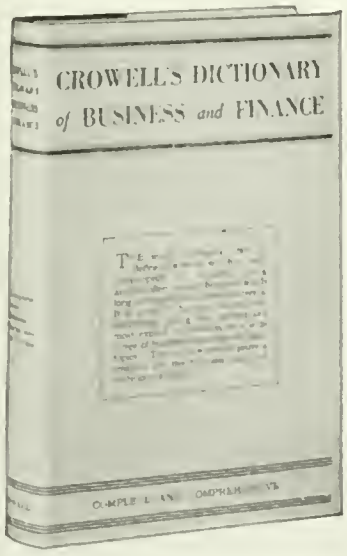

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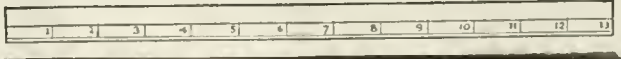

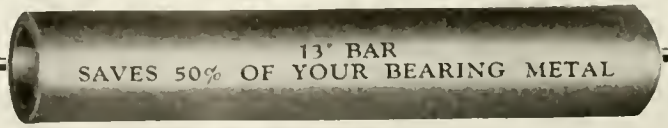

MANAGEMENT AND ADMINISTRATION

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Frank A. Fall George E. Hagemann

Vol. VII

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The Cover Illustration is a view of the Baltimore Refinery of the American Sugar Refining Company

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Authors and Articles in this Issue

HOWARD COONLEY, President of the Walworth Manufacturing Company, in "The Executive Airplane" draws an analogy between the bird's-eye view of the underlying landscape viewed from a flying aeroplane, and the clean-cut overlook of business conditions afforded by the operation of a modern forecasting system. The article is the last of the series, "How the Walworth Company Looks Ahead," written, save as to the present article, by Mr. Barber, statistician of the company.

J. H. Bliss, Controller of Libby, McNeill and Libby in "The Operating and Financial Ratios Characteristic of Industries," shows how operating and financial ratios vary with the particular industry, and emphasizes the fact that these ratios must be kept within the proper range if the business is to be safe and successful.

Geoffrey C. Brown contributes "Profitable Methods for the Small Shop". Mr. Brown has had a wide experience in factory organization with several of the largest manufacturing companies in this country, and also with smaller ones. At the present time he is chief engineer of a small factory, and writing from his immediate experience.

How, and to what extent, financial and cost information should be furnished to department heads is discussed by G. M. Pelton, of Swift and Company, Chicago, in "Supplying Financial and Cost Information". Accounts, Mr. Pelton says, should deliver accurate cost figures to executives and department heads, who should understand them and use them "vigorously".

In "Organization of the Production Division," Frederick A. Waldron continues the series which began in the January issue. In this instalment the author develops the duties, organization, and functions of the production department, following the lines of his previous article on the engineering division.

"Executive Control of Future Results," by Wallace Clark, suggests a method whereby those phases of the business which "are not moving at the desired rate" or in which "something has happened which was not expected" are automatically indicated so that they receive the special executive attention they require.

In his article, "Operating Adjustments Under Standard Costs," R. W. Darnell, Controller of the Ritter Dental Manufacturing Company, points out the variations which may occur between standard and actual costs in labor, material, and overhead, and shows how these discrepancies may be adjusted.

William A. Vollmer, of the Robert Gair Company in "Fiber Shipping Case Economies," points out the savings in weight, cost, storage space, and shipping charges resulting from the use of fiber boxes of which several types are illustrated, with economy figures.

"Pricing Policy in Relation to Financial Control," by Donaldson Brown, Vice-President of General Motors Corporation, advances the idea that a sound, comprehensive pricing policy is one of the most important elements in effective financial control. The second part of the article will appear in MANAGEMENT AND ADMINISTRATION for March.

In "Absentism Factors for Industrial Plants," J. D. Hackett, consultant on labor problems, discusses absence among the working forces of industrial plants, covering its nature, causes, relative importance, comparing its extent in various industries, and, in concluding, suggests preventive measures.

The Fordham-Tingley series is continued in "Applying the Budget to Industrial Operations". After the budget has been assembled, it must be worked into such shape that it may be used in the planning of financial, production, and sales operations. Its adaptation and application to these purposes are explained.

"Savings from Conveyor and Molding Equipment," by Robert T. Kent, Mechanical Engineer, explains how costs can be lowered and production increased by applying management principles and labor-saving equipment to foundry operations.

Following Dean Kimball's articles, Frederick C. Mills, Assistant Professor of Business Organization, at Columbia University, begins the series on "Economic Problems of Industrial Organization," discussing the chief factors of industrial production—natural resources, capital, population, organizing ability, and the business unit.

The cover illustration—the Baltimore Refinery of the American Sugar Refining Company—was secured through the courtesy of its designing engineer, Charles T. Main.

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THE PUBLISHERS' PAGE

Access to a Billion-Dollar Annual Market for Industrial Equipment

A Magazine Achievement

READERS of MANAGEMENT AND ADMINISTRATION will be interested in the record made by their magazine in reaching the vast market for industrial equipment. At first thought it may seem almost an impossibility to cover even a minor part of this market through the pages of a single publication. In the United States there are 290,105 manufacturing establishments according to the census of 1919. But difficult as it may have been, MANAGEMENT AND ADMINISTRATION already has secured the coverage of a principal part of this extensive market, and in so doing has to its credit an achievement of the first order.

THE **possibility of this achievement** is shown by a few figures. Of the nearly 300,000 manufacturing plants only 16,437[1] employ 101 workers or more. These 16,437 establishments employ 6,435,861 workers out of a total of 9,096,372. That is, one-eighteenth of the industrial plants employ nearly three-fourths of all the workers in American industry, and purchase a similar proportion of the industrial equipment which is installed every year.

Because of this concentration of the industrial market it is possible for one magazine to secure a circulation covering a principal part of American industry, and that with practically no waste. Concretely, this is what MANAGEMENT AND ADMINISTRATION has achieved.

TURNING again to figures, the census of 1919 gives the **capital invested in the manufacturing establishments** in the United States as something over $44,000,000,000. MANAGEMENT AND ADMINISTRATION reaches the management of $25,000,000,000 of this huge total, or more than one-half.

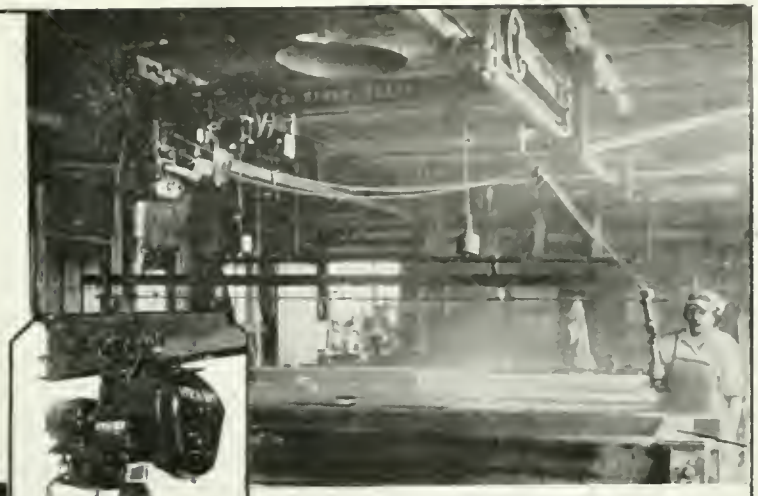
To show what this means in an annual market it is but necessary to use a conservative replacement percentage of, say, 4 per cent. Applying this factor we realize that there is a yearly market of more than $1,000,000,000 for plant, materials, and equipment represented by the $25,000,000,000 capital investment to which MANAGEMENT AND ADMINISTRATION gives access.

THIS position of strength has been reached through the carrying out of a **definite policy**—to publish a magazine to aid and assist the management in carrying on great enterprises. It is the only magazine that touches all the problems of effective and complete managerial control.

In order that the magazine may hold this position the publishers definitely commit themselves to keep it directly and constantly useful to all who are responsible for the management and administration of industrial enterprises, to help solve their problems, to assist in establishing and suggesting sound principles, and to present all obtainable information bearing upon improvement in operating procedure. This pledge is to the readers both present and future. A result of this policy will be the continuous development of the magazine in the field of industry and the extension of its coverage in the vast market for industrial equipment.

[1] Statistics from the United States Census of 1919.

In Dust—Grit—and Acid Fumes



This Hyatt equipped Stamp hoist, used by a chemical plant, to and from a dipping vat, is constantly enveloped in acid fumes.

A one-ton Stamp hoist manufactured by the Stamp Electric Hoist Company, Cleveland, Ohio, embodying seven Hyatt bearings.

A Stamp hoist, equipped with Hyatt roller bearings, handling loads of brick from kiln to truck. Continually covered with brick dust and grit.

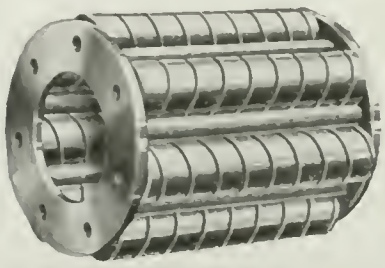
The efficient operation of Hyatt equipped cranes, trolleys and hoists is not hampered by the unfavorable conditions under which they work. These machines are fortified against any damage from the dirt and grit that settles on them.

The sturdy construction of Hyatt bearings enables them to withstand overloading and severe emergency duty. Even abuse and neglect at the hands of unskilled labor fail to cause any trouble. These bearings give smooth, uninterrupted service, year in and year out, without adjustment or replacement.

Even in the presence of acid fumes the efficient operation of Hyatt equipped handling machinery is not retarded. The distinctive features of the bearing housing and of the roller bearing itself insure complete and continuous lubrication. And it is only necessary to oil once every three or four months.

Hyatt equipped machines save operating power and labor, and speed up the work. The crane shown above as used in a chemical plant is operated through the entire working day by one girl, eliminating additional labor formerly required for the same work. The ease with which these machines may be moved and controlled makes them well adapted to use by girls.

Whatever the conditions under which your trolley, crane and hoist must operate, you will find that a Hyatt equipped installation will handle larger tonnage at lower costs.



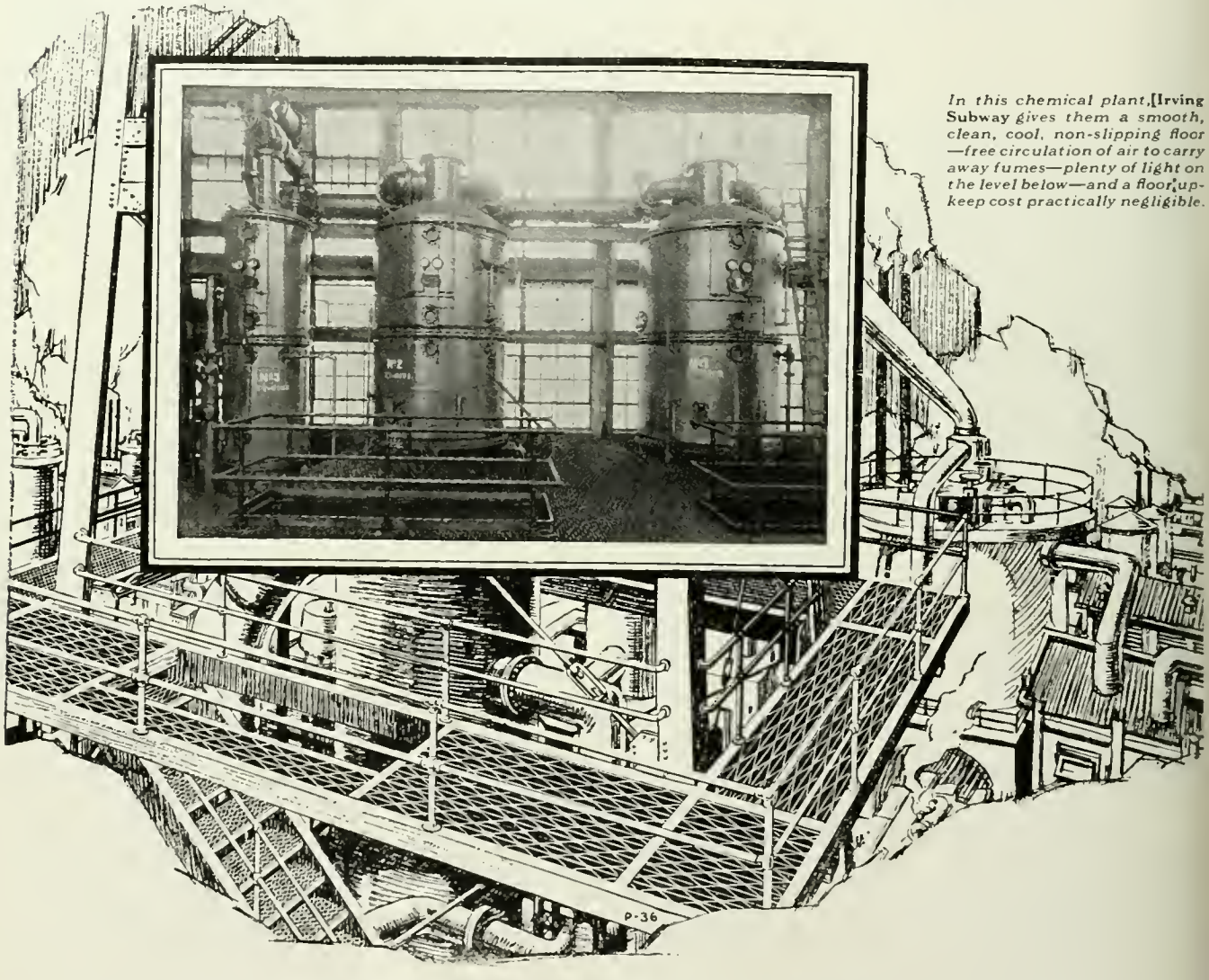
Hyatt Roller Bearing Company

Newark Detroit Chicago San Francisco

Worcester Milwaukee Huntington Minneapolis Philadelphia Cleveland Pittsburgh Buffalo Indianapolis

IRVING SUBWAY
TRADE (PATENTED) MARK

THE FIREPROOF VENTILATING FLOORING



In this chemical plant, **Irving Subway** *gives them a smooth, clean, cool, non-slipping floor —free circulation of air to carry away fumes—plenty of light on the level below—and a floor upkeep cost practically negligible.*

Light weight, unequaled strength, convenient sized panels, ease of installation, a smooth but permanently non-slipping surface, 80% open area for light and air, tremendous shock resistance, the rigidity of a solid floor, the durability of steel—these are some of the features which are making **Irving Subway** the standard general-purpose industrial flooring.

And back of **Irving Subway** is the largest plant in the world producing open steel flooring—a specialized experience of more than 12 years in industrial flooring problems—a corps of engineers skilled in the manufacture and installation of steel industrial flooring and its application under all conditions, for all purposes. Send us your lay-outs and let us work with you in securing the advantages and economies of this safe, time-proof, wear-proof open steel flooring. And ask for Catalog 4A44.

IRVING IRON WORKS CO.
LONG ISLAND CITY, N.Y., U.S.A.

CONDITIONS AND PROSPECTS IN BUSINESS AND INDUSTRY

PREPARED BY LEWIS H. HANEY

Director, New York University Bureau of Business Research

Barometer of Industry and Trade

Period of Recession Appears to Have Ended

In December there was another decided upswing in the main forecasting line of Fig. 1. This fact, taken together with the other indications shown in the accompanying graphs, leads to the conclusion that there will be improvement in business throughout the greater part of 1924. No indication of any important setback has yet appeared.

The actual volume of business, as distinguished from the forecast for the future, is now nearing the bottom. In fact, the low level has been reached in some industries already, and with few exceptions the general upward movement should begin by March at the latest. Business men may, therefore, make commitments from now on with increasing confidence.

The large increase in the P/V line in December was caused by a decline in the physical output and distribution of commodities, accompanied by a price level which remained practically unchanged. This condition indicates that the decreased volume is not caused by lower prices. Its significance is that it shows supplies being reduced to a level where demand will become stronger. We are in the final stages of a liquidation process in production. *After a very considerable recession in business, a readjustment in the industrial output is paving the way for a more active demand and firmer prices.*

The decreases in production in basic industries (see Fig. 2), which characterized November and December is reassuring. It means less danger of a premature increase in output, which, had it come, would have speedily led to overproduction.

One of the most reassuring developments has been the movement of the unfilled orders of the United States Steel Corporation. As forecast last month, the turn in this important index appears to be at hand. Larger bookings caused the unfilled orders as of December 31, to show the usual seasonal gain. This brings a long period of decline to an end. The actual upturn, after allowing for seasonal variation, may not come at once, but it will not be long delayed.

[1] Assisted by Horace J. Barney, Harry Comer, and Stephen DuBrul of the Bureau's staff.

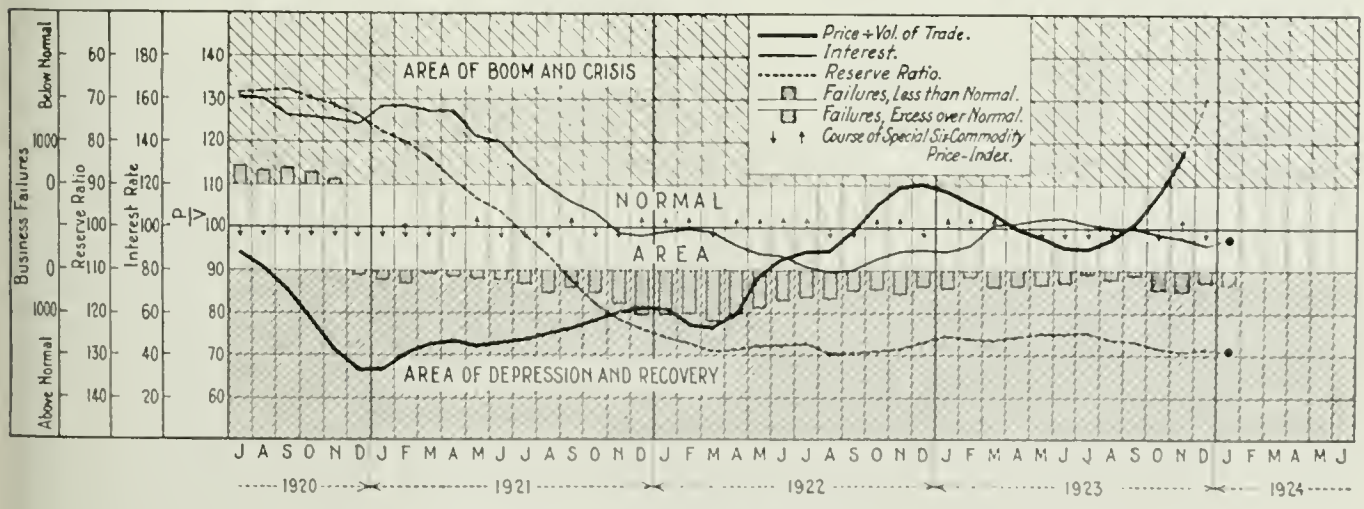

Price+Vol. of Trade.
Interest.
Reserve Ratio.
Failures, Less than Normal.
Failures, Excess over Normal.
Course of Special Six-Commodity Price-Index.
AREA OF BOOM AND CRISIS
NORMAL AREA
AREA OF DEPRESSION AND RECOVERY
Business Failures
Below Normal
Above Normal
Reserve Ratio
Interest Rate
P/V
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1920
1921
1922
1923
1924

FIG. 1 THE BAROMETER OF INDUSTRY AND TRADE

The P/V line (drawn heavy) is the business forecast line. It shows the trend of commodity demand, and is the ratio between Bradstreet's index of wholesale prices and the physical volume of trade (carloadings times tons per car), based on 1912 as the normal year. It is plotted as a three months' moving average, centered successively on the middle months, except that the final dotted portion of the line runs to the actual figure for the last month. A rise in the curve indicates increasing demand, and vice versa. The interest rate curve has been corrected for seasonal variation, and index number 100 equals 5 per cent. The federal reserve ratio of cash reserves to note and deposit liabilities is inverted to harmonize its indications with the rest of the curves, and is corrected for seasonal variation. Business failure bars are based on Dun's reports, and normal is taken as the trend for 40 years. The six-commodity price index is based on special investigation by the N. Y. U. Bureau. January 1924 data shown are probable trends. Areas in which curves lie indicate that business is good, normal, or poor.

Readers should remember that the present trend of industrial activity, as measured by current volume of production or sales, is still slightly downward or nearing the bottom. December figures show several new lows and some further declines are probable in January. The point is that the *forecasts* are favorable. Present declines have been discounted. The *future* is bright.

We can now begin to measure the magnitude of the 1923 recession. The price level at its lowest point was down about 8 per cent from the peak. Production in manufacturing industries has fallen off about 9 per cent from its peak. Production in all basic industries declined about 10 per cent. Railway tonnage after allowing for seasonal variation has fallen off about 16 per cent.

Volume of business at present is just about the same as it was at the end of 1922 and prices are only a little lower on the average. The difference is that *then* prices were nearing their peak and physical volume of production was becoming dangerously large, while *now* production and the price level are becoming fairly stabilized at a relatively low point, with the chances good for future increase on a more normal basis.

The evidence is growing that at the outset the recovery in 1924 will be but moderate, while later on in the year the gains will be more rapid and larger. One of the chief reasons for anticipating but moderate recovery in the early part of the year is the present *declining tendency of purchasing power* among the mass of the people. At the present time employment is gradually diminishing owing to the declining volume of production, and as a result the average weekly earnings of laborers have become slightly less than they were a month or two ago. At the same time the cost of living continues to rise. Under these circumstances an immediate boom is not to be expected. But as production increases, as we predict it will in the spring, this situation will change and the purchasing power of the people will again increase.

On the whole the foreign outlook shows improvement. Recent serious declines in French and British exchange rates, while they tend to restrict our exports and indicate some growing inflation abroad, suggest that the very seriousness of the situation will lead to measures designed to bring about a final readjustment. Already the attitude of France has changed and there is hope that the present conference concerning reparations will mark the beginning of a final adjustment.

Greater optimism concerning the domestic political situation is probably warranted by recent developments. The outlook for lighter taxes and for staving off the soldiers' bonus is improved. It is probable that the radical and conservative elements in Congress are so evenly balanced that no seriously harmful legislation can be put through.

There follows a list of the favorable and unfavorable indications as revealed by the various data set forth below.

Favorable Factors

1. Unfilled steel orders cease decline.
2. Mail order and chain store sales increase. (Fig. 10).
3. Failures decrease.
4. New enterprises increase. (Fig. 12).
5. Pig iron production increases. (Fig. 3).
6. Building activity increases. (Fig. 6).
7. Stocks of several important commodities decrease. (Table 1).
8. Price level is stable. (Fig. 11).
9. Abundant credit. (Figs. 1 and 13).
10. Stock market rises. (Fig. 8).

Unfavorable Indications

1. Slight setback in purchasing power.
2. Strained conditions in the cotton textile industry.
3. Relatively large stocks of a few commodities such as pig iron and zinc.
4. Volume of "business," as measured by bank and postal receipts, slightly declining.

We must conclude that *signs of any approaching depression are absolutely lacking. Business and industry appear to be nearing the bottom of the 1923 recession.* There must either be a recovery or we must proceed along present levels. *With so many favorable factors and signs of an approaching upturn, the chances favor a moderate recovery in the spring which will gain momentum as the year proceeds.*

Production and Stocks of Commodities

Production Still Declines: Stocks Being Adjusted

Stocks of Commodities

The index of gasoline stocks shows a decrease from October to November of 4 per cent, the first decrease since December 1922. This indicates that the oil industry is in a stronger position, not only as to crude supply, but also as to the chief refined product. (See Table 1).

Zinc stocks on January 1 showed an increase of about 17 per cent, the eighth consecutive month showing a rise. This indicates a somewhat weaker situation in the industry on the supply side. Demand, however, has been somewhat more active.

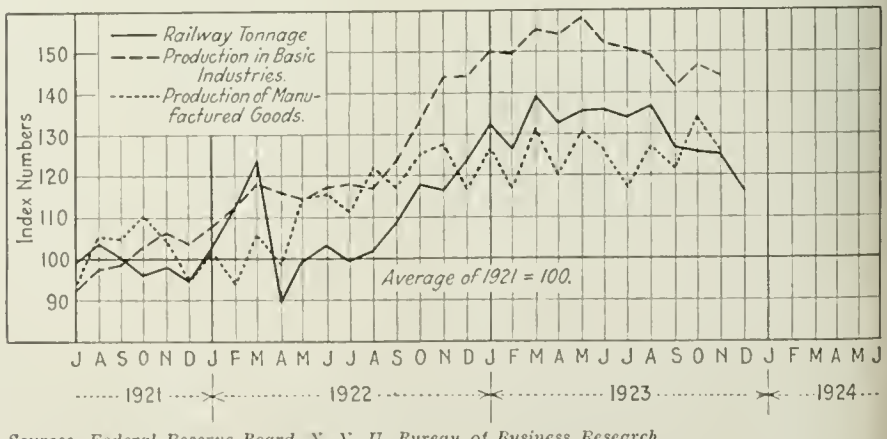
Automobile tire stocks show a decline from October to November. (Production of tires is increasing, however, owing to a strong demand from automobile manufacturers.)

Stocks of cattle leather show a fair decline, which is a healthful development. Cotton-seed oil stocks remain at the same level (after correction for normal seasonal variation). Pig iron stocks are still too heavy.

Conclusion. On the whole, it seems that in most cases burdensome stocks of basic commodities are being reduced.

Production and Railway Tonnage

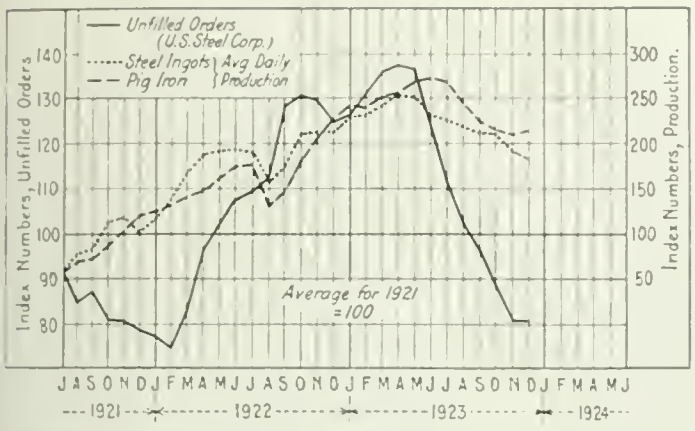
Fig. 2 shows that according to the latest data there has been a continued decline in the various indexes of physical volume. The Federal Reserve Board's index of production in basic



Sources, Federal Reserve Board, N. Y. U. Bureau of Business Research

FIG. 2 RAILWAY TONNAGE AND PRODUCTION IN INDUSTRY

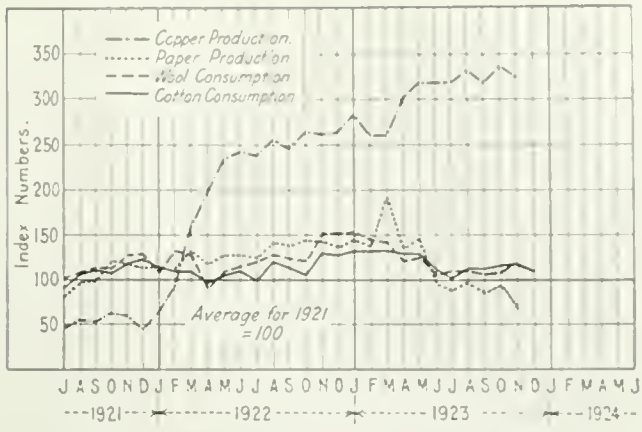
Railway tonnage and production in basic industries corrected for seasonal variation, and the latter also for normal growth.


Unfilled Orders (U.S. Steel Corp.)
Steel Ingots } Avg. Daily
Pig Iron } Production
Index Numbers, Unfilled Orders
Index Numbers, Production.
Average for 1921 = 100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921 1922 1923 1924

Sources, Iron Age, American Iron and Steel Institute

FIG. 3 IRON AND STEEL PRODUCTION AND UNFILLED ORDERS

Corrected for seasonal variation.


Copper Production
Paper Production
Wool Consumption
Cotton Consumption
Index Numbers.
Average for 1921 = 100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921 1922 1923 1924

Sources, American Bureau of Metal Statistics; American Paper and Pulp Association; Bureau of Census; Dep't of Commerce.

FIG. 4 PRODUCTION IN FOUR IMPORTANT INDUSTRIES

Cotton and wool corrected for seasonal variation.

industries declined from 146 in October to 144 in November. The index of production in manufacturing industries between the same months fell from 133 to 126. Railway tonnage declined from 126 in October to 125 in November, and then fell to 116 in December. (All these figures are based on the average for 1921 as 100.)

Conclusion. That there has been a sharp decrease in the quantity of goods produced is apparent, and a further decrease in the production in basic industries is likely. In view of the danger of overproduction which existed during the first half of 1923, however, this decrease is wholesome and may be considered as a necessary correction and adjustment in the industrial mechanism.

Iron and Steel Production

Production. During December the average daily production of pig iron, Fig. 3, decreased 2 per cent, but *when corrected for seasonal variation the index registers an increase of 2 per cent.* The average daily production of steel ingots, however, showed a decline of about 5 per cent from the November level of output. It seems probable that December saw the bottom of steel ingot production. The data follow:

Average Daily Production (Tons)

	Pig Iron	Steel Ingots
Nov.	96,476	119,800
Dec.	94,225	113,700

Unfilled Orders. Unfilled orders of the U. S. Steel Corporation increased 1.5 per cent during December, all of which increase is merely seasonal, *leaving the corrected index of unfilled orders for December unchanged from the November index.*

Unfilled orders of 111 Merchant Pig Iron furnaces as of November 30 were 1,265,518 tons, an increase of 105 per cent over the preceding month. Most of this iron was ordered for the first quarter of 1924. The stocks of merchant iron showed an increase of 8 per cent during the same month. During December the iron market was not active and no considerable new buying has developed. *Prices are fairly steady at the current quotations and production increased during December. Pig iron is not likely to show any sustained advance at present, since merchant furnaces have not reduced output.*

Steel buying has increased somewhat and a fair spring business is expected in that industry. On January 8, *The Iron Age* composite steel price remained unchanged at 2.775 cents per lb.

Conclusion. Railway orders for rails and other track material have been good. The automobile and building industries show signs of heavy demand. Hence, the iron and steel outlook is good.

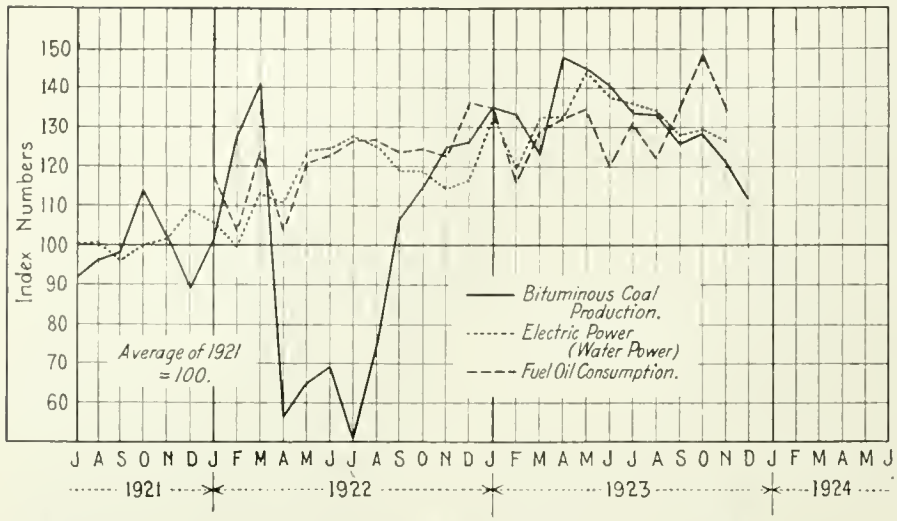
TABLE 1. STOCKS OF IMPORTANT COMMODITIES ON THE FIRST OF THE MONTH
(Index Numbers: Average for 1921 = 100)

Month and Year	Gasoline*	Leather (Cattle)	Zinc	Newsprint Paper	Automobile Tires	Raw Sugar*	Cotton-Seed Oil*	Merchant Pig Iron	Dept. of Com. Index of Stocks—31 Commodities
	100 = 630,757,000 gals.	100 = 19,742,000 pieces	100 = 77,202 tons	100 = 30,009 tons	100 = 1,361,000 tires	100 = 114,000 tons	100 = 255,400,000 lbs.	100 = 634,950 tons	100 = 139.7
July 1921	103	100.5	116.4	88.7	95.2	109.0	118.5	109.5	97.6
Aug.	109	99.5	119.7	85.0	89.2	77.0	123.0	109.5	93.5
Sept.	108	99.5	112.1	90.4	90.2	87.0	129.5	100.0	93.8
Oct.	109	96.4	105.1	100.8	76.6	116.0	60.0	94.0	94.7
Nov.	102	95.9	91.7	76.7	81.2	69.0	71.0	82.0	93.7
Dec.	102	95.2	86.8	77.1	89.6	96.0	84.0	80.0	95.2
Jan. 1922	103	98.5	78.5	79.8	81.7	95.0	92.0	86.0	92.8
Feb.	110	99.0	85.1	88.5	95.6	88.0	84.0	90.5	90.6
Mar.	110	100.7	83.1	92.7	107.5	136.0	82.0	86.0	89.8
Apr.	110	95.4	78.1	93.9	118.8	183.0	84.0	84.5	85.9
May	110	101.5	67.0	82.9	125.2	140.0	89.0	70.0	76.0
June	111	101.6	52.3	82.6	126.6	105.0	82.0	52.5	74.5
July	114	98.3	38.3	77.9	115.5	107.0	84.0	49.0	73.8
Aug.	123	97.1	37.1	70.5	110.8	151.0	87.5	38.0	71.3
Sept.	133	91.5	28.0	66.3	106.1	132.0	89.0	25.0	70.2
Oct.	146	90.2	24.1	62.7	105.7	122.0	37.0	23.8	88.0
Nov.	161	87.7	23.4	65.8	107.3	70.0	35.0	25.0	88.9
Dec.	160	85.9	25.3	65.4	113.8	55.0	42.0	29.8	83.7
Jan. 1923	156	85.3	23.6	64.0	105.4	55.0	52.0	35.8	84.5
Feb.	156	84.0	21.5	76.7	107.6	76.0	60.0	43.0	79.1
Mar.	154	82.6	14.1	77.3	119.7	86.0	64.5	44.0	78.9
Apr.	162	81.6	13.0	67.2	129.9	168.0	67.0	38.0	73.6
May	164	81.1	11.6	62.9	139.3	147.0	69.0	41.7	72.1
June	173	82.1	16.9	60.5	153.6	97.0	71.0	53.6	72.6
July	174	82.8	22.2	65.0	161.4	97.0	76.0	72.7	73.8
Aug.	185	83.6	27.5	74.0	148.0	96.2	74.0	97.5	78.9
Sept.	199	81.3	31.1	85.5	138.5	81.8	57.4	111.0	80.1
Oct.	206	81.2	29.6	82.2	123.2	130.4	28.0	121.7	89.4
Nov.	211	85.4	33.4	82.4	111.7	102.8	43.0	131.0	
Dec.	202	81.5	40.3	80.0	107.5	89.8	43.3	141.0	
Jan. 1924			47.3						

* Adjusted for seasonal variation.

Production in Important Industries

Copper and Paper. Our index of copper production for November, in Fig. 4, shows a decline of 3 per cent be-



Sources, Department of Interior; Bureau of Mines; United States Geological Survey

FIG. 5 FUEL AND POWER PRODUCTION

Bituminous coal and electric power corrected for seasonal variation.

low the level of output during October. However, this industry is still producing beyond the demand for its product at a price which would be profitable for many mines.

Paper production during November was only 93 per cent (estimated) of the production during October, but some of this decline is seasonal and the outlook for the industry is considered rather good.

Cotton and Wool Consumption. Following an increase in November, the consumption of cotton decreased during December by 12.5 per cent, which was more than the normal seasonal decline. As a result, our adjusted index shows a decrease of 7 per cent. Raw cotton has had a setback under the influence of larger ginning figures and curtailed mill activity; but the supply still seems inadequate and the price is not likely to go much lower. Cotton goods are mostly firm, but there is a tendency to curtail production to a basis of stocks on hand, as difficulty is experienced in disposing of goods at prices based on present raw material prices.

Wool consumption fell slightly, but, as this decline was considerably less than the normal decrease for November, *our index of wool consumption increased from 105.8 to 120.2, or 13.5 per cent.* The outlook for wool and woolens is somewhat better, with prices firm to rising.

Fuel and Power

Coal. The production of coal during December, after correction for the usual seasonal change, decreased 8 per cent from the November level of output. (See Fig. 5).

Fuel Oil. The index of fuel oil consumption for November is 10 per cent below the October index. Some of this movement may be seasonal, however.

Hydroelectric Power. Hydroelectric power production for November is 3 per cent below that of October, after correction has been made for the seasonal influence.

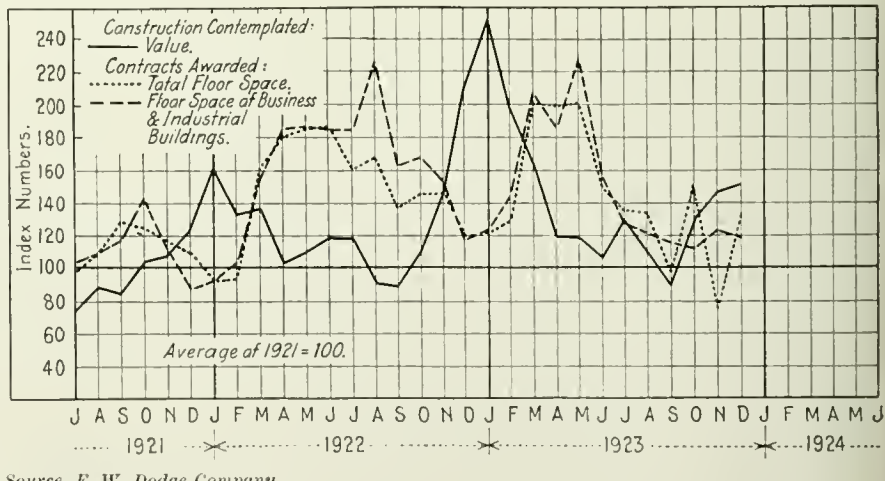
Conclusion. The decrease in these indexes of fuel and power reflect the current decrease in production in basic industries.

Building Activity in December

Building activity in December, Fig. 6, shows several decided changes from November.

Contemplated Construction. According to information furnished by the F. W. Dodge Company, contemplated construction declined 3.5 per cent, but this is less than the normal seasonal decline, and when adjusted for the seasonal influence the index is 151.2 as compared with the November index of 147—an increase of 3 per cent.

Contracts Awarded. The index of total building contracts awarded rose from 76.2 in November to 133.2 in December. The index of contracts awarded for business and industrial buildings, however, declined from 122.6 to 118.7, or 3 per cent.



Source, F. W. Dodge Company

FIG. 6 BUILDING CONSTRUCTION AND FLOOR SPACE IN CONTRACTS AWARDED

Construction contemplated corrected for seasonal variation.

Conclusion. It is still too early to predict building activity in 1924 with certainty. Contracts awarded are at about the same level as a year ago, and therefore, it is clear that there will be a high level. But "contemplated construction" is at present considerably lower than last year and may forecast a smaller increase in activity than occurred in 1923.

Trend of Trade and Finance

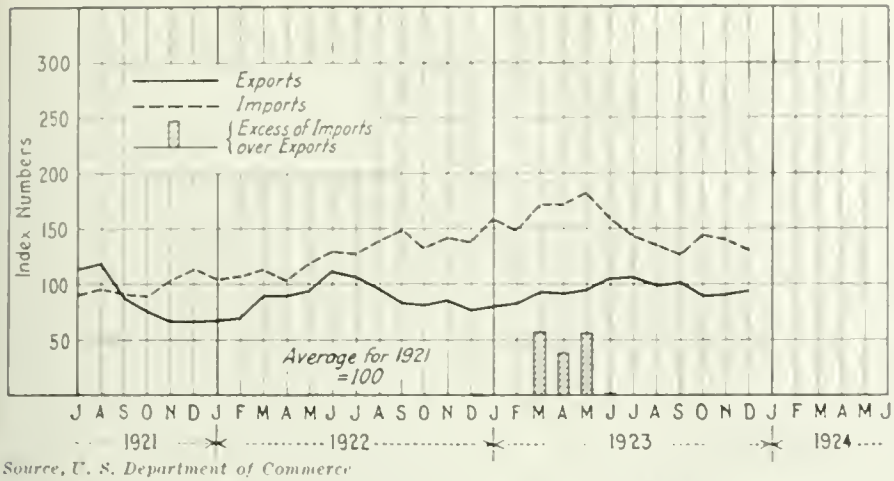
Trade Stable: Money Conditions Remain Favorable

Exports and Imports

The December merchandise exports increased, and imports decreased. (See Fig. 7). High cotton prices affected exports, and reduced production cut down imports of raw materials.

New York Stock Exchange

The New York Stock Exchange (see Fig. 8) was strong all through December and the upward trend has been continued down to the middle of January. The average price of 50 stocks on De-



Source, U. S. Department of Commerce

FIG. 7 FOREIGN TRADE OF THE UNITED STATES

Corrected for seasonal variation.

cember 15, was 83.56, on January 12, the average had advanced to 85.42, a gain of 1.86 points.

At the same time there was a marked increase in activity on the stock exchange. The week ended January 12, showed an average daily turnover of 1,259,000 shares, the highest of any week on record during 1923 or 1924 to date. On the whole, the volume of trading has followed the average price of stocks; the increases coming on price advances.

Conclusion. It seems safe to predict a continuation of the general upward trend of the stock market and February will probably see a further gain in the average. The stock market is now discounting the improved outlook for 1924.

Bank Debits and Postal Receipts

Bank Debits. As to bank debits, December is usually a high month. It is therefore not surprising to find that after eliminating normal seasonal movement, the index of the average weekly debits to individual accounts reported by nearly 250 centers this year just about held its own. (See Fig. 9).

Postal Receipts. The unadjusted index of postal receipts for 50 selected cities, during December, gained 18 per cent over the November figure. December receipts are usually the largest in the year. After allowing for seasonal variation, it is found that there was but little change in activity during the month.

Conclusion. These indexes are among the best for showing the trend of business. Both postal receipts and bank debits have held up well in spite of current recession in production. It is clear that there has been a slight slackening of activity, but business is becoming more nearly stable.

Retail Trade

Mail Order Sales. The December sales of Montgomery Ward and Sears-Roebuck totaled $35,860,000, as compared with $34,528,000 in November. After allowing for the usual seasonal variation, it is found that the gain was more than the usual seasonal increase. The adjusted index is 134.5 for December, against 130.0 for November. (See Fig. 10. The average for 1923=100.)

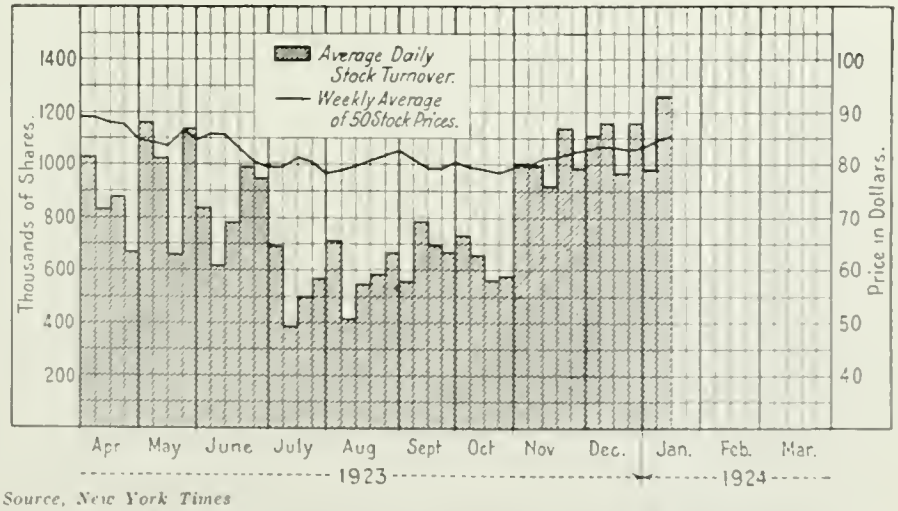
Chain Stores Sales. The adjusted index of the December sales of four large chain store systems shows a gain of 9 per cent over the November figure. This means that December sales were the largest in history.

Department Store Sales. After adjustment, the November index of department store sales—the latest available—stands at 111.6 as compared with 115.8 for October.

Conclusion. It is apparent that retail trade is progressing at a high level. The growth in the mail order business, which reflects conditions in rural sections, is especially encouraging.

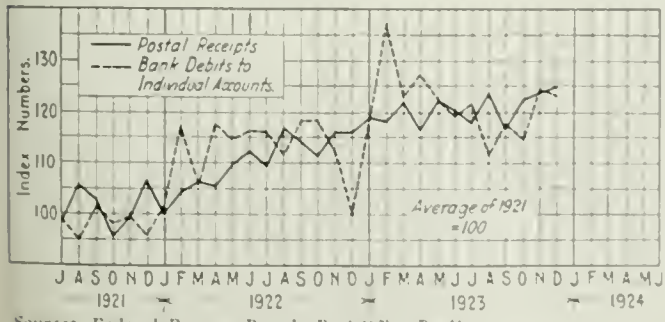
Prices and Interest Rate

Prices. Fig. 11 shows that the indexes of prices and money rates have moved downward slightly. Bradstreet's



Source, New York Times

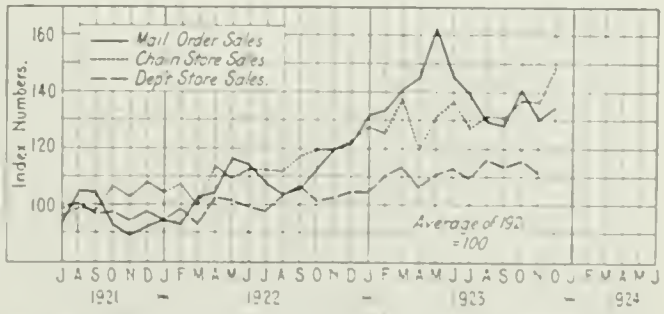
FIG. 8 STOCK TURNOVER AND PRICES ON NEW YORK STOCK EXCHANGE


Postal Receipts
Bank Debits to Individual Accounts
Index Numbers.
130
120
110
100
Average of 1921 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Federal Reserve Board; Post Office Dep't.

FIG. 9 BANK DEBITS AND POSTAL RECEIPTS

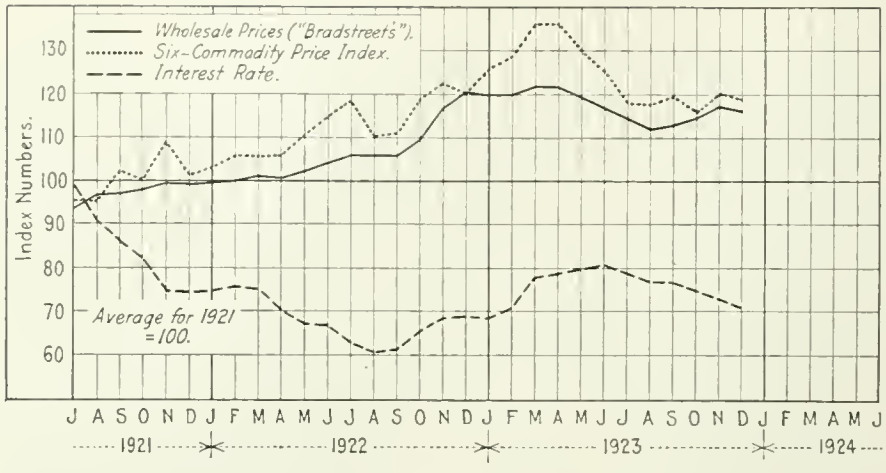
Both curves corrected for seasonal variation.


Mail Order Sales
Chain Store Sales
Dep't Store Sales.
Index Numbers.
160
140
120
100
Average of 1923 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Commercial and Financial Chronicle; Federal Reserve Board

FIG. 10 SALES OF MAIL ORDER, CHAIN AND DEPARTMENT STORES

2 mail order houses; 4 chain stores; 306 department stores. Corrected for seasonal variation.


Wholesale Prices ("Bradstreets").
Six-Commodity Price Index.
Interest Rate.
Index Numbers.
Average for 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Commercial and Financial Chronicle, Federal Reserve Board

FIG. 11 WHOLESALE PRICES AND INTEREST RATE

Interest rate is the monthly average, corrected for seasonal variation.

index of wholesale prices as of January 1, indicated a decline of 1.2 per cent.

It is apparent, therefore, that there is now an irregular condition of stabilization in the general price level. While to be followed by a moderately advancing trend. The interest rate on commercial paper generally follows the price level about 6 months later, and it is, therefore, likely that interest rates will become stabilized about February fol-

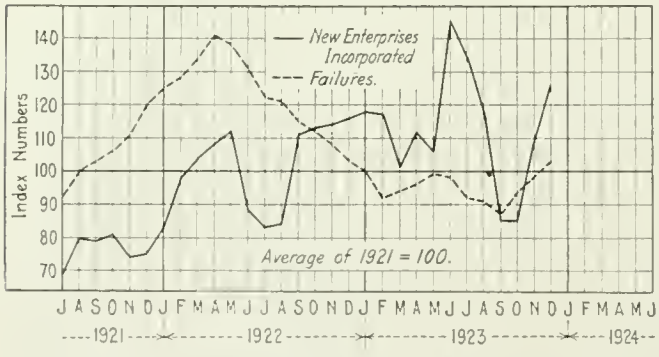
business enterprises continues to move upward. After eliminating seasonal variation, our index shows a gain from 126 in November to 147 in December (the average for 1921 being 100).

Failures. Business failures, after allowing for the usual seasonal change, declined decidedly in December which is a very favorable indication. Our index in November was 106.6 and it dropped to 97 in December.

Conclusion. The business birth rate has risen while the death rate has declined. This double movement indicates that the turn from the recession of 1923 is at hand. It reflects the beginning of confidence in the outlook for 1924 and recovery from the period of readjustment that characterized the second half of 1923.

Bank Credit

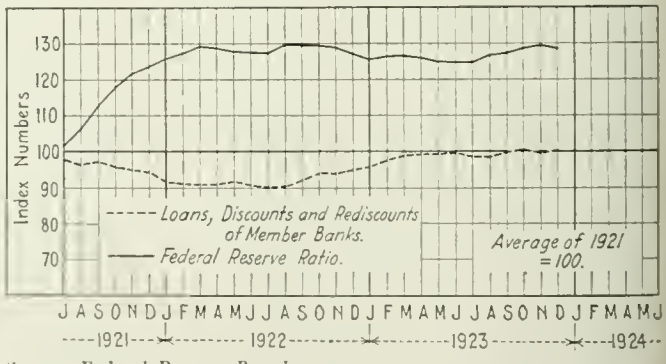
Loans and Discounts. Total loans and discounts of the 764 reporting member banks of the federal reserve system were $11,934,334,000 on December 26. This is a gain of less than 3/10 of one per cent over the previous month. (See Fig. 13).


New Enterprises Incorporated
Failures.
Index Numbers
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Dun's Review; N. Y. Journal of Commerce

FIG. 12 BUSINESS FAILURES AND NEW ENTERPRISES

Adjusted for seasonal variation; curves plotted as 3 months' moving average.


Index Numbers
Loans, Discounts and Rediscounts of Member Banks.
Federal Reserve Ratio.
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Source, Federal Reserve Board

FIG. 13 BANK CREDIT AND FEDERAL RESERVE RATIO

Federal reserve ratio is ratio of total reserves to note and deposit liabilities and has been corrected for seasonal variation.

some further slight declines may occur it is believed that the general trend of prices during the first half of 1924 will be moderately upward.

Interest Rate. The course of the interest rate on high-grade commercial paper shows that money has become easier. The index after adjustment for seasonal variation dropped from 72.8 in November to 70.4 in December (the average for 1921 being 100). Thus the level of money rates is approximately 30 per cent under the depression period of 1921. Certainly with commercial paper moving at 4¾ per cent no money difficulties are in sight.

Conclusion. Prices, though varying widely among different commodities, show a sort of stabilization at the end of the 1923 recession in business. The outlook is for a little further irregularity lowed by firmer rates about the middle of 1924.

Failures and New Business Enterprises

December figures indicate a decided improvement in the business outlook, and Fig. 12 reflects this improvement in part.

New Enterprises. The volume of new

Federal Reserve Ratio. After correction for seasonal variation, the December index of the ratio of reserves to deposit and federal reserve note liabilities combined, decreased slightly to 128.6 from the November figure of 129.1.

Conclusion. Indications are that although the member banks have extended a large amount of credit, they have had little recourse to the reserve system.

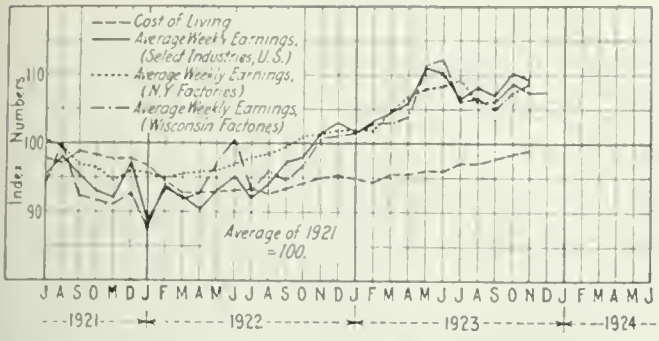
Wage and Employment Situation

Employment Still Declines: Earnings Stable

Earnings and Cost of Living

The trend of average weekly earnings and the cost of living are shown in Fig. 14. Earnings are down for most of the country, while the cost of living has increased.

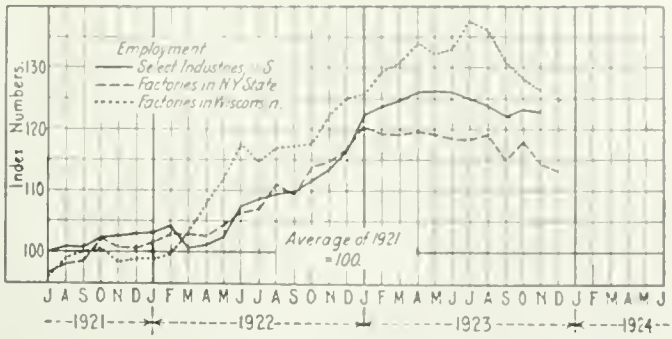
New York Earnings. Earnings of factory workers in New York State, after a small decrease in November, in-


Cost of Living
Average Weekly Earnings, (Select Industries, U.S.)
Average Weekly Earnings, (N.Y. Factories)
Average Weekly Earnings, (Wisconsin Factories)
Index Numbers
Average of 1921 =100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921 1922 1923 1924

Sources, U. S. Bureau of Labor Statistics; N. Y. State Dep't of Labor; National Industrial Conference Board

FIG. 14 WAGES AND COST OF LIVING

New York and Wisconsin factories curves corrected for seasonal variation.


Employment
Select Industries, U.S.
Factories in N.Y. State
Factories in Wisconsin
Index Numbers
Average of 1921 =100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921 1922 1923 1924

Sources, U. S. Bureau of Labor Statistics; N. Y. State Dep't of Labor

FIG. 15 THE TREND OF EMPLOYMENT

Corrected for seasonal variation.

creased slightly in December. They are still about 6 per cent higher than at the same period last year.

Wisconsin Earnings. There was an increase in the seasonally corrected index of earnings in Wisconsin. This was due to the actual decrease being less than is normal in November. The November index stands at 108.6. This is the highest since June of this year, and is 8 per cent over November of last year.

Selected Industries in the United States. In November the Bureau's index decreased 0.5 per cent to 109.6. It is not corrected for seasonal variation.

The largest decrease was in the boot and shoe industry. There were moderate decreases in car-building and repairing, and iron and steel, which are heavily weighted in computing the index. Earnings are still at a satisfactory level, being 8 per cent above those of November of last year.

Cost of Living. The cost of living index increased about 0.6 per cent in November. This index has increased gradually since June of this year. It is now at the highest point since May 1921.

Conclusion. The purchasing power of labor as measured by the margin between average weekly earnings and the cost of living is continuing the decline of the last several months. Labor's purchasing power, however, has not yet been substantially curtailed and labor is still in a position to buy freely.

The Employment Trend

New York State. Employment in factories went down about 1 per cent in December after adjustment for seasonal variation. Lessened activity in the clothing trades, except in men's clothing shops, was largely responsible for the decrease. Mild weather and reduction of working forces following preparation for the holiday season were factors.

Wisconsin. In November there was a slight decrease in the actual number of persons employed, which was accentuated in the adjusted index as there is normally an increase in employment at this period. The adjusted index now stands at 126.4; the average for 1921 being 100. (See Fig. 15).

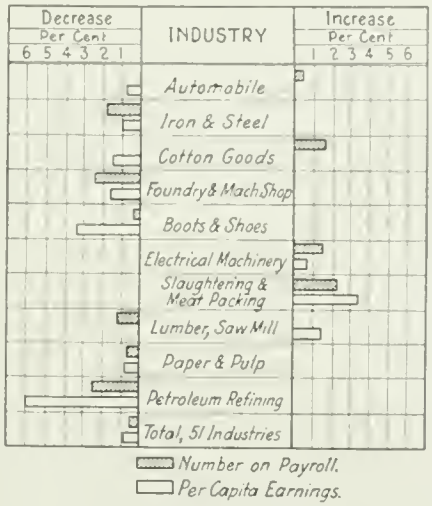


FIG. 16 TREND OF EMPLOYMENT AND EARNINGS, NOVEMBER 1923

United States. Employment throughout the entire country declined 1.5 per cent in December, however, 18 industries showed increased employment. The largest increase was in the automobile tire industry, 7.2 per cent. The largest decrease was in sugar refining, 24.7 per cent.

Conclusion. The decrease in employment at the present time, rather than reflecting dull business, shows the prevailing tendency to keep production correlated with current needs. There is no general unemployment and working forces are being maintained in numbers considerably above those of 1921.

Employment and Earnings in Selected Industries

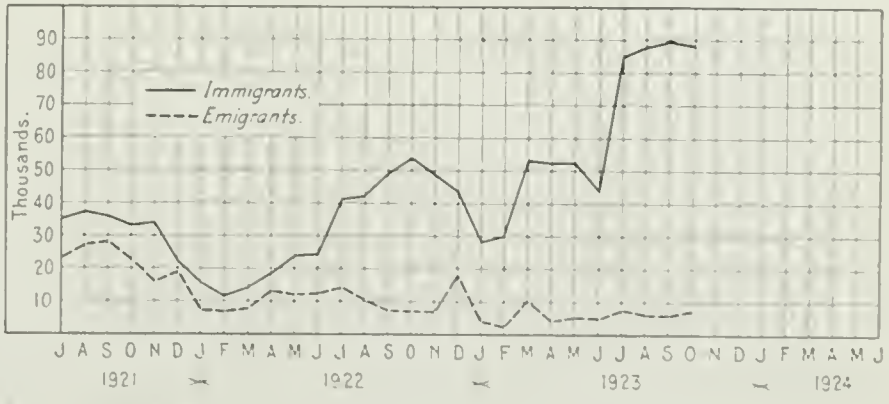
Changes in employment and earnings during November are shown, in Fig. 16, for the 10 leading industries in the United States.

Employment. On the whole there was a decrease in employment during November which amounted to 0.5 per cent for the total of 51 industries on which the Department of Labor reports.

Per Capita Earnings. Earnings also were lower in November. The average decrease for the 51 industries was 0.9 per cent.

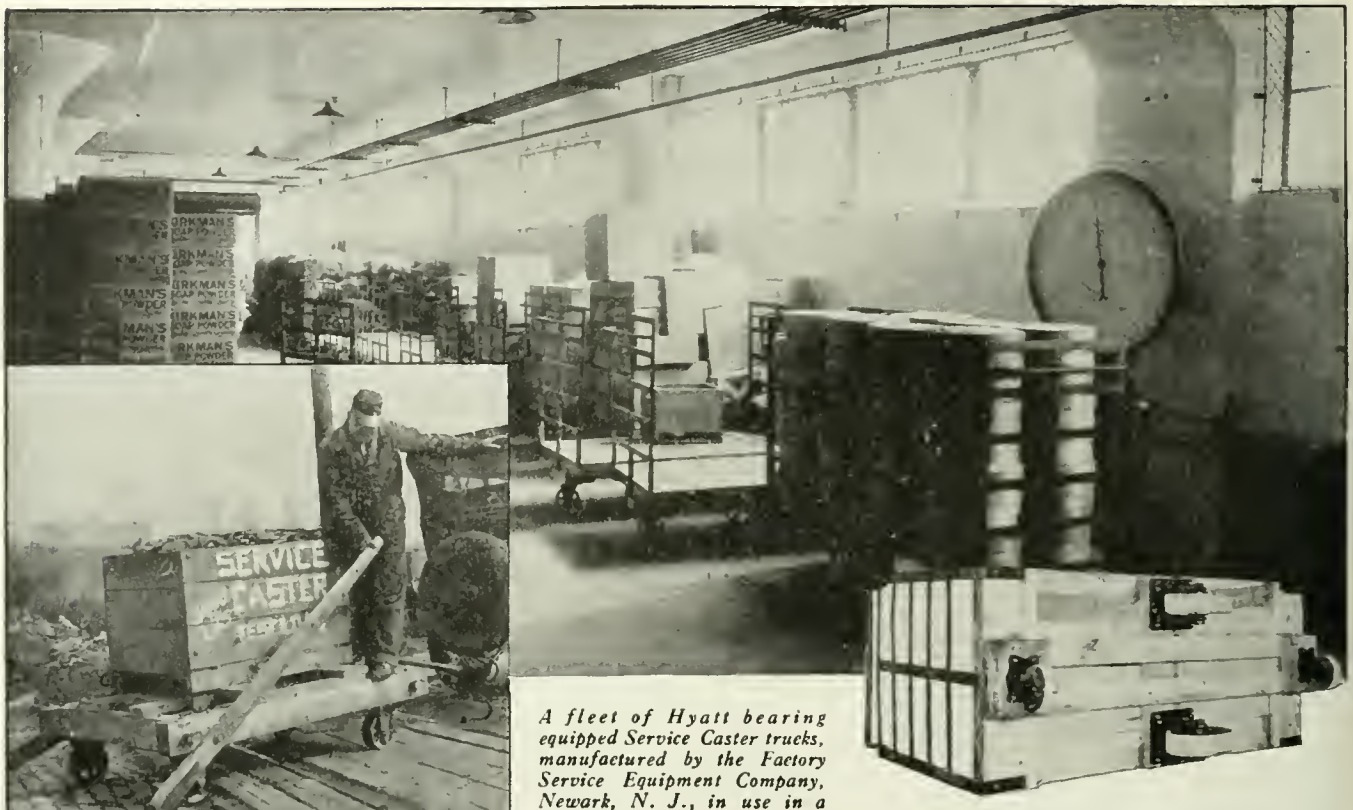
Immigration and Emigration

The latest available figures show a slight decrease in the net gain of population from immigration. (See Fig. 17).



Source, United States Bureau of Immigration

FIG. 17 IMMIGRATION AND EMIGRATION



A fleet of Hyatt bearing equipped Service Caster trucks, manufactured by the Factory Service Equipment Company, Newark, N. J., in use in a warehouse.

Showing the simple method of applying Hyatt equipped Service Casters to trucks.

Test of a Hyatt equipped Service Caster truck under 3,000 lb. load over poor city streets. Rough treatment caused no breaks or noticeable wear.

Modern Warehouses and Factories Should Use Modern Trucks

The severe requirements placed on trucks by present day handling methods are fully met by Service Casters equipped with Hyatt roller bearings.

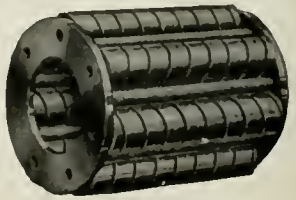
The sturdy construction of Hyatt bearings enables these already strong casters to stand up under overloading and the shocks of bumping on and off elevators, and over door sills and uneven loading platforms.

Oiling is necessary only three or four times a year. These hollow, oil retaining bearings save oil and lubricating labor.

Labor and power saving is accomplished by the easy rolling motion of the Hyatt bearings. In the warehouse shown above one man pushes the truck and makes up the job lot orders.

By specifying that your trucks, trailers and other handling machinery be equipped with Hyatt roller bearings you can speed up the work and reduce labor and maintenance costs.

Complete information will be furnished on request.



Hyatt Roller Bearing Company

Newark Detroit Chicago San Francisco

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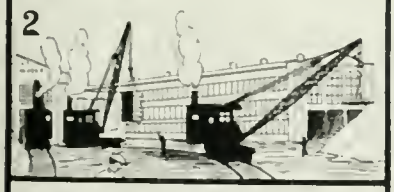
Why Industrials Excel

1

All units of INDUSTRIAL cranes are built complete in one plant. Raw materials are cast, forged, machined and assembled under the guidance of chemical and physical laboratories and are subject to hundreds of inspections during this progress.

2



Every INDUSTRIAL locomotive crane is completely assembled and thoroughly tested under its own power before shipment. Full capacity loads are handled under actual and severe service conditions. A sworn statement of the test accompanies each crane.

How Would YOU Like To Save $25,000 This Year?

THIS INDUSTRIAL LOCOMOTIVE CRANE actually saves $24,397.50 a year for the Pennsylvania Salt Mfg. Co., handling ore, coal and like materials at Greenwich Point, Philadelphia, Pa. Placed in operation in 1903, it has already rendered twenty-one years of highly efficient service and is still producing an annual dividend of approximately double its purchase price.

This saving is well within reason when you consider the extreme flexibility of INDUSTRIALS' material-handling work. Operating with clamshell bucket they unload, store and rehandle all bulk materials such as coal, coke, sand and gravel. With electric magnet they handle all iron and steel shapes, scrap, rails and pig iron. With hook and block they make heavy unit lifts well in excess of their rated capacities.

Plant conditions vary greatly, of course, and we have had fifty years of experience in applying INDUSTRIAL equipment to thousands of individual material-handling requirements. Our sales engineer in your vicinity will gladly give you the benefit of this fifty years of locomotive crane experience without obligation.

A copy of the 164-page Golden Anniversary catalog, illustrating and describing the 17 types of INDUSTRIAL cranes and other material-handling equipment will be forwarded promptly upon request.

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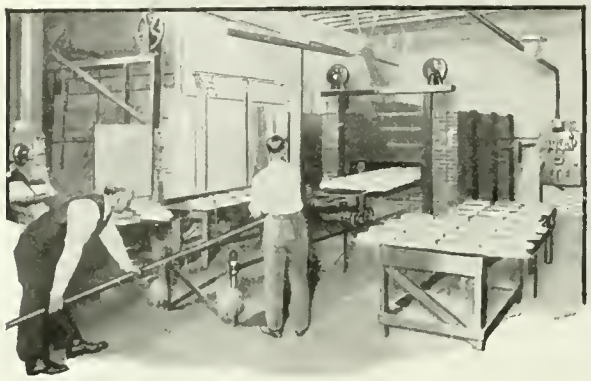
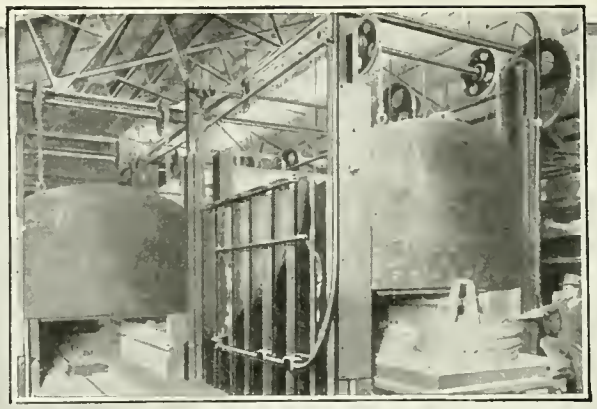
Locomotive Cranes, 5 to 200 Tons -- Transfer, Pillar & Gantry Cranes
Railway Pile Drivers -- Combination Crane Pile Drivers -- Transfer Tables
Portable Rail Saws -- Grab Buckets -- Magnets -- Steam Pile Hammers

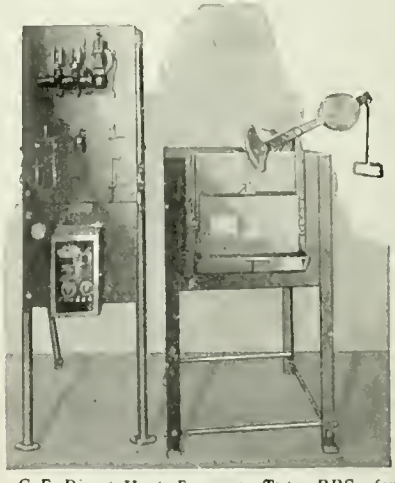
INDUSTRIAL LOCOMOTIVE CRANES



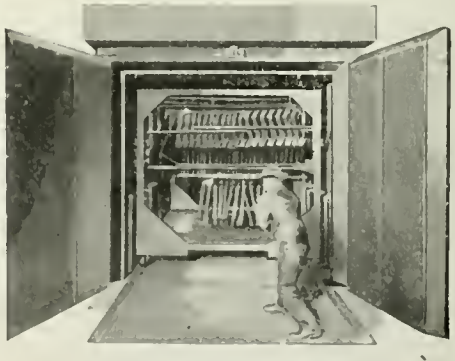
Firing vitreous enamel in a furnace equipped with G-E Direct-Heat Units and Automatic Control.



Compensating Type Electric Furnace equipped with G-E Direct-Heat Units, and Automatic Control



G-E Direct-Heat Furnace, Type RRS—for heat treating tools, heat treatment research in laboratory, and many other heat treating processes up to 2000° F.



For japan baking ovens the General Electric Company manufactures a complete line of electric heating equipment with automatic control

Smokeless, Flameless Heat

The old problems of Industrial Heating—combating combustion handicaps, uneven heat, rejections—no longer trouble the man who uses electric furnaces and ovens.

Vitreous enameling, attended by numerous disadvantages of old time methods, has been simplified and improved by the use of electric furnaces equipped with heating units of G-E Direct-Heat design. Temperature is easily maintained. There is no muffle to sag and break. The number of heats a day is increased, the quality of the product is higher, and rejections due to soot or fumes are unknown.

The electric compensating furnace for annealing is so arranged that the cooling charge coming out of the furnace preheats the cold charge on its way in. This furnace has proved especially valuable in annealing wire—greatly speeding production.

In the new G-E Direct-Heat Furnace, Type RRS, there is no muffle interposed between the resistor and the charge. The heat radiates direct to the charge, which makes heating quicker and control easier.

The General Electric Company also manufactures small electric heating devices—giving to industry the broad use of electricity for practically every heating purpose.

General Electric Company
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GENERAL ELECTRIC

39-85

MANAGEMENT
AND
ADMINISTRATION

VOLUME VII FEBRUARY, 1924 NUMBER 2

The Executive Airplane*

By HOWARD COONLEY

President, Walworth Manufacturing Company

THE war wrought many changes. As seems to be the law of nature, unwholesome results showed themselves immediately and in abundance. More gradually out of the confusion are appearing new movements of great hope. Among those already listed on the asset side none has been more evident than the general urge for wider education—particularly for education in business. Another generation will find the old, crude, unintelligent methods a thing of the past. Requirements for the industrial executive will be almost as severe as those for a doctor or lawyer.

We do not have to turn back many pages in the record of the past to find the time when balance sheets were figured but once a year; when there was no current knowledge of business progress and the eleven months' happy dreams of profits were in the twelfth turned into a nightmare of disappointed hopes. We used to buy material and fabricate it as long as our money lasted, and then curtail our purchases and production until our revived balances made it possible to go ahead. Inventories were a thing about which we gave little thought until we found that they had accumulated and could not be readily liquidated.

Howard Coonley

Salesmen rushed into our office fluttering large specifications and insisting that in order to meet John Smith's price we would have to figure low. We sat down at our high-piled desk, sharpened our pencil, figured the material that would go into the job, the labor that would be necessary to produce it, and added it to our supposed overhead. I can remember even the words that the estimator invariably used. "Our overhead is actually no more than 30 per cent, but in order to play safe I will call it 45." So on this basis with the addition of a meager amount for our eagerly hoped-for profit, we went after the business and generally got it. When the year ended and we had taken time to put our accounting house in order, we invariably wondered why the earnings we had supposed were piling up were nowhere to be found.

Index Number
338.97 Forecasting production

Those were indeed the days of business by "main force and awkwardness." Fortunately times have changed. The old-school executive is being slowly but surely relegated to the scrap heap, and his place taken by the trained administrator. Success still requires the old elements of courage, perseverance, and unremitting effort. In addition, however, it calls for a new degree of intelligence and foresight. The executive of the future will be rated by his ability to anticipate his problems rather than to meet them as they come.

In all of this we may take great satisfaction. It gives

* The December number of MANAGEMENT AND ADMINISTRATION contained the sixth article of the series, "How the Walworth Company Looks Ahead," written by the statistician of the Walworth Manufacturing Company, Joseph H. Barber, and describing the scientific and effective methods of forecasting employed by that company. Mr. Coonley's article concludes this series with a general survey of the possibilities of forecasting and the place it should occupy in modern business.

new hope and new courage to realize that we can forecast the future accurately, and by the ability to forecast, can spread our net so as to capture all the fish in our part of the water. There is a new sense of power in the knowledge that a man can set up his target, draw his bow, and watch his arrow hit the bull's-eye clean.

A few days ago I had one of the most inspiring experiences of my life. I took my first journey in an airplane. I had supposed that I should be disturbed by the immediate prospect of the flight; that as the plane got under way I should be dazed at the giddiness of the height and somewhat upset by the unsteadiness of the breeze. It was with a strange surprise, therefore, that I stepped into the car, felt it swing into line, start ponderously over the field and finally ascend gently into the air, without throb of the heart or shiver of a single nerve. As we soared over the water at Winthrop Beach, circled about the State House, Bunker Hill Monument, the Harvard Stadium, and finally swooping low over South Boston, came almost within reach of our Walworth plant, I felt a thrill of joy and a mastery over things material that had never come to me before. From my great elevation I had the sense of being able to pick up the toy city in my hand and play with it as I pleased. Yet, should any part of the tiny panorama perplex me, a word to my pilot at any moment would swing me low for a close-up view of any object I might desire to scrutinize. I could almost persuade myself that I could pull out the tiny stacks and bays of the Walworth plant and shift them about at my pleasure. In fact I had that magnificent sense of power that must have come to the conquerer of olden times when he had captured a new citadel. Nor did the descent to the hard earth and the subsequent winding of my way around the narrow lanes of Boston rid me of that grip on myself and on the world in general that I gained high in the air.

During my leisurely walk to my office my mind was very active. It ran back to the time, not many years ago, when I read with smiling scepticism of the courageous labor of the Wright brothers to create a vehicle that would supply them with the wings of a bird. Such efforts then seemed valueless to heredity. Such a strange vehicle could be destined only to cause the destruction of its creators. Yet here I had that very afternoon made use of the imagination of those great men in such a practical way as to convince me that the airplane would be one of the machines of great commercial use within the period of my own lifetime. And as my mind went on to play with such comparisons, it was brought back very vigorously to those same few years ago when I, as a skeptic, failed to see in the records of the past the parts with which to build an executive airplane for the future—a plane from which I could view my company's activities in perspective, and from the height to which they carried me, shift the parts to suit my purpose. Or, when I desired, I could swoop down to get a close-up view of some particularly difficult problem.

At last I reached my desk and drew before me the little black folder that contained the bird's-eye view of my business. My hands grasped it eagerly just as before they had gripped the sides of the cockpit.

In this, my executive airplane, I find a single-sheet panorama of my business—of all its buying and selling, its receiving and paying. For a forward look toward the horizon, there is my tentative plan for the coming year. Yet with a twist of the hand, a close-up view lies before me in greater detail of the months just ahead, a detail adjusted and revised at my will. Familiar marks orient me as I land on solid earth, perusing the local topography revealed by some current report. And, as I wind my way through the byways of the various units and the master monthly financial statements, I still feel the thrill of that firm grip on myself and on the world as a whole which I first sensed during my airplane flight.

THE output of the Walworth Manufacturing Company consists of pipe fittings, valves, and tools. The annual production is approximately 50,000 tons. By far the larger part of this is used in repair work, which necessitates quick deliveries and this, in turn, calls for a complete and adequate stock of finished goods aggregating over 23,000 different finished articles.

The difficult problems involved in a business of this nature and magnitude have brought about the development of a singularly thorough and scientific system of forecasting and budgetary control. This system and its operation have been described in considerable detail by Mr. Barber, statistician of the Walworth Company, in preceding numbers of MANAGEMENT AND ADMINISTRATION. Of its operation, Mr. Coonley says:[1]

"Here are the results for the year 1922: Our actual sales came within 5 per cent of our estimate. Cumulatively the first six months were 8 per cent in excess of the estimate; the first nine months were 4.3 per cent, but the full year's figures were so close to the estimate as to be a coincidence. We do not expect again to equal this particular record. . . . Having this advance information, we were able to decide on a production plan that would give us an even flow of material throughout the year, building up our stocks in the spring and summer months to meet the fall demand. This accomplished not only better service to our customers but greater economy of production, more even employment for our workmen, and a great decrease in labor turnover. It enabled us to anticipate our material requirements and to take advantage of low price conditions. It gave our treasurer exact information as to financial requirements. It made it possible for me to place before our directors a definite estimate of the amount of money that would be involved in producing in advance the excess stock necessary for fall delivery, and it justified them in adopting the program because I could assure them that this investment would be liquidated before the end of the year. It enabled us to set up an ideal inventory for the end of the year and to work toward final liquidation to this ideal point. It proved that this inventory control was practicable because we came within the limit. . . .

"Budgetary control is now one of the fundamental policies of the Walworth Company. It is our record of the past, our index for the present, and our guide to the future. We believe it to be an essential factor in our success." —THE EDITORS.]

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[1] *Harvard Business Review*, July 1923.

The Operating and Financial Ratios Characteristic of Industries

"Capital Requirements and Control"—Article Three

By J. H. BLISS

Controller of Libby, McNeill and Libby

Index Number
658.14 Financial control
338 Production

IN a general way most business activities other than those of an agricultural nature may be classified into groups along the following distinct lines:

Manufacturing	Insurance
Merchandising	Agencies and commission
Transportation	
Public utilities	
Mining	
Banking and financial	
Fiduciaries	
Institutional	
Professional	
Miscellaneous	

Considering these general divisions of industries it is at once apparent that great differences exist in the types of operations performed and services rendered, and that these various industries must of necessity have different individual characteristics. Beyond that, within manufacturing industries, there are many and various lines of business—the Census Report, for instance, specifies more than 350 distinct manufacturing industries. Among these are widely varying operations and processes and material differences in the character of the services performed.

The viewpoint maintained in this article is that of the manufacturing and merchandising industries. However, many of the principles stated herein, for manufacturing and merchandising businesses, are quite applicable to others of the industries mentioned.

There is less uniformity and standardization of accounting practices in manufacturing and merchandising industries than there is in railroads, public utilities, banks, and insurance companies, and there is less possibility of uniformity. This emphasizes the necessity for recognizing sound accounting and business principles in handling accounts and preparing reports for manufacturing and merchandising concerns. The field for accounting services in these industries is broader than in others and the possibilities for development far greater.

The gross margin, the relation between manufacturing or buying costs and selling prices, is highly characteristic of the different lines of business. The margin which an industry has to work on tends to such a figure as will cover the costs and expenses of the average organization engaged in that line of business and leave a fair return on the capital used.

Referring to the distinctive differences between the various industries, Mr. Bliss says: "Differences in operations performed and services rendered are necessarily reflected in differences in organization, differences in financial structure, and differences in accounting procedure. These result directly in differing relationships, ratios, and turnovers. The ratios, turnovers, and relationships common in any line should be considered as the personal characteristics of that particular industry." The present article gives these "personal characteristics" for some of the more important lines of industry and shows their importance as indicia of trend and condition.

The relation of expenses to the volume of business done, indicated by expense ratios, is likewise highly characteristic of various industries. These relationships depend entirely upon the character of the operations performed, and the services rendered. The ratios of labor costs, factory expenses, selling, advertising, and administrative expenses are distinctive characteristics of different lines of business. Some industries have expensive factory operations, others have relatively inexpensive processes; some businesses carry heavy selling and general expenses, while others characteristically have much lighter general overhead expenses. In some industries the value added by manufacture is as low as from 8 to 12 per cent of the sales value of products; in others it is as high as from 70 to 80 per cent of the sales value of the products. When a man buys a cash register, upwards of 80 per cent of his payment is disbursed for manufacturing and distributing services. Of the sum he would pay for a pound of butter or meat, only 10 or 15 per cent is required for manufacturing and distributing services.

Characteristic Ratios of Operating Results

With highly characteristic gross margins and expense ratios it follows that there are characteristic ratios of operating results in different lines of business. The margin of operating results on sales is of necessity wider in those lines which have slow turnover and may be much narrower in other lines with rapid turnover and still permit both types of industries to earn about the same average return on invest-

ment used. In some businesses the annual sales average is as low as ¼ of the total investment used, and a very wide margin of operating profits is necessary to yield a fair return on such investment. In other lines of business the annual sales may be as much as three or four times the amount of capital used, with the result that a narrow margin of operating profits on sales would yield a satisfactory return on the investment used. Different industries, therefore, have characteristic margins of operating profits, which are the direct result of the types of operations and business conducted. Of course, these margins are affected by changing general business and competitive conditions from time to time.

Each industry has characteristic turnovers of capital tied up in accounts receivable, in inventories, and in plant investment. The terms of sale vary widely in different lines; some businesses sell on a cash basis, others extend credit for long periods. These terms affect the amount of capital necessary to carry customers' accounts and are, therefore, reflected in the turnover of accounts receivable. In some lines of business it is necessary to carry stocks of goods for longer periods than in others; in some industries the manufacturing processes require very short periods of time, while in others many months may be consumed. The function of certain businesses is to render a storage service, carrying seasonable products from times of production and plenty, to times of scarcity and demand. At the other extreme would be merchandising industries with very rapid turnover of stocks of goods.

Some industries require only relatively small investments in production facilities, while others because of the type of the operations performed have to maintain extensive and costly plants. No one would think of trying to manufacture steel products in a packing house, nor make butter in a foundry. Obviously the type of operations or services rendered by a business requires a certain type of plant and equipment. These are highly characteristic of different industries. It follows naturally that the investment tied up in plants in different industries bears a characteristic relationship to the volume of business done, as well as to the total amount of capital used in the conduct of a business. These relationships are expressed in the turnover on plant investment and in the relation of plant investment to total capital employed.

Characteristics Within Industries

Within an industry different concerns will naturally have somewhat different characteristics, though as a whole their operations and transactions must measure up to competitive standards if an average return is to be earned on the investment used. Of course variations will occur in individual ratios and turnovers. Some companies will enjoy a better gross margin than others, perhaps because of better merchandising, quality of product, method of distribution, or services rendered. Some may have more economical and efficient operations than others. Some may enjoy better turnovers of accounts and inventories than others. Some may have more advantageous turnovers on plant investment than others. A going concern will seldom be found best in every relationship, and certainly not the poorest in every one, but, far and wide, the various companies in an industry necessarily have to average out to competitive standards as a whole, if they are to realize the competitive average return on the investment used.

Statistics on Volume Costs and Margins

Some idea of the characteristics of various industries and the wide variation between different lines of business may be obtained from the following table of statistics prepared from the 1914 and 1919 abstracts of the Census of Manufactures. The columns of this table show for the more important industries of the country:

1. The value of the products.
2. The cost of materials used, including fuel.
3. The value added by manufacture, which would include all expenses and profits.
4. The total wage and salary payment.
5. The percentage of value added by manufacture to the value of the product, which indicates clearly the wide variation in gross margins on sales.
6. The ratio of wages to the sales value of the product, stated in percentages, which indicates the widely varying amounts of labor necessary in different lines of business.
7. The percentage of all other expenses and profits to sales value of products.

After deducting the wages from the value added by manufacture the balance remaining has to cover all other expenses and profits. It is impossible to separate these elements from the statistics available, but the figures will serve to indicate the wide variation between industries in the amount of expenses and the possible margins of profit. They also indicate the widely varying relationships between prices, costs, and wages in the various industries.

Table 1 gives statistics on about 40 of the more important industries of the country. The Census Report classifies the industries covered in 342 separate kinds of manufacturing establishments in 1914, and 356 in 1919. The total number of establishments covered by the Census survey was 275,791 in 1914 and 290,105 in 1919.

The expansion of industrial activities over the war period with surprisingly stable relationships is worthy of note. Table 2 shows the figures for all manufacturing industries covered by the census statistics.

The increase in the value of products from 24 billions to 62 billions is tremendous. Of course, the larger part of this increase is due to higher prices. Wholesale price indices indicate that the 1919 price levels were about double those of 1914, but after allowing for this there is apparent a substantial increase in the physical volume of production of these manufacturing industries.

Similar relative increases in costs of material, gross margins, wages and salaries are particularly noteworthy. One of the striking features of the period of expansion was that prices, wages, and profits increased in about the same proportion. The figures for each sepa-

TABLE 1. STATEMENT COMPARING, FOR DIFFERENT INDUSTRIES, THE VALUE OF PRODUCTS, COST OF MATERIALS, WAGES, ETC.

Data from Abstract of Census of Manufacturers, 1914 and 1919—(000's Omitted)

Industries	(1) Value of Products	(2) Cost of Materials	(3) Value Added by Mfg.	(4) All Wages and Salaries	(1) Value of Products	(2) Cost of Materials	(3) Value Added by Mfg.	(4) All Wages and Salaries	(5) Per Cent Value Added by Mfg.		(6) Wages Per Cent to Value of Products		(7) Per Cent Other Exp. and Profits to Value of Products	
	1914	1914	1914	1914	1919	1919	1919	1919	1914	1919	1914	1919	1914	1919
All Industries in Total	$24,246,435M	$14,308,089M	$9,878,346M	$5,366,249M	$62,418,079M	$37,376,380M	$25,041,699M	$13,423,972M	40.7	40.1	22.1	21.5	18 6	18 6
Agricultural implements	$164,086M	$73,508M	$90,578M	$47,604M	$304,961M	$144,573M	$160,389M	$88,630M	55 2	52 6	29.0	29.1	26.2	23.5
Auto bodies and parts	129,601	63,610	65,990	54,552	692,171	362,027	330,144	213,924	50.9	47 7	42.1	30.9	8.8	16.8
Automobiles	503,230	292,597	210,632	84,901	2,387,903	1,578,652	809,251	379,382	41.9	33.9	16.9	15.9	25.0	18.0
Boots and shoes	501,760	310,356	191,403	128,623	1,455,041	715,269	439,772	268,860	38.1	38.1	25 6	23.3	12 5	14 8
Bread and other bakery prod	491,893	274,257	217,635	96,634	1,151,896	713,239	438,657	207,057	44.2	38.1	19.6	18.0	24 6	20.1
Brick and tile, terra-cotta	135,921	42,723	93,198	65,154	208,423	67,488	140,935	94,097	68.6	67.7	48.2	45.2	20 4	22.5
Butter	243,379	212,546	30,832	14,090	583,163	514,346	68,817	28,575	12.7	11.8	5 8	4.9	6.9	6.9
Canning fruits and vegetables	119,175	103,293	45,882	22,412	402,243	265,629	136,614	56,944	30.7	34.0	15.0	14.2	15.7	19.8
Cars & shop cons & rep. stm. R. R	514,041	243,828	270,213	258,549	1,279,235	515,803	763,422	754,565	52.6	59.7	50.3	59.0	2.3	.7
Cash registers	30,520	3,992	26,528	11,592	83,539	10,890	72,649	36,520	87.0	87.0	38 0	31.7	49.0	55.3
Cement	101,756	51,987	49,770	24,258	175,265	79,510	95,755	42,641	48.9	54.6	23.8	24.4	25.1	30.2
Chemicals	158,054	89,451	68,603	31,087	438,659	216,301	222,358	97,189	48.4	50.6	19.7	22.1	23.7	28.5
Clothing, men's	458,211	230,032	228,179	113,800	1,162,986	605,752	557,234	259,165	49.8	47.9	24 8	22 3	25.0	25 6
Clothing, women's	473,888	252,345	221,543	118,697	1,208,543	680,407	528,136	254,332	46.7	43.7	25 0	21.0	21.7	22 7
Cotton goods	676,569	431,603	244,967	161,680	2,125,272	1,277,786	847,486	392,839	36 2	39.8	23.9	18.4	12.3	21.4
Electrical machinery	335,170	154,728	180,442	109,098	997,968	425,098	572,870	336,369	54.9	57.4	32 6	33.7	22.3	23.7
Fertilizers	153,196	107,955	45,242	17,774	281,144	185,041	96,103	36,935	29.5	34.2	11 6	13 1	17.9	21 1
Flour and grist-mill products	877,680	752,270	125,410	40,963	2,052,434	1,799,181	253,253	82,901	14.3	12.4	4.7	4 0	9.6	8.4
Foundry and machine-shop prod	866,545	358,122	508,423	328,550	2,289,251	948,069	1,341,182	804,346	58.6	58.6	37.9	35 1	20.7	23.5
Glass	123,085	46,017	77,069	55,205	261,884	90,780	171,104	100,891	62.6	65.3	44.9	38 7	17.7	26 6
Knit goods and hosiery	258,913	146,687	112,225	71,039	713,140	427,096	286,044	157,526	43.3	40.1	27.5	22.1	15 8	18.0
Iron and steel, blast furnace	317,651	261,580	53,074	28,895	794,467	621,286	173,181	87,201	16.7	21.8	9 1	11.0	7.6	10.8
Iron & steel, st. wks & roll. mills	918,665	590,826	327,839	225,658	2,828,902	1,680,576	1,148,326	737,518	35.7	40.6	24.6	26 1	11.1	14 5
Leather	367,202	284,245	82,956	30,291	928,592	646,522	282,070	108,384	22.6	30 4	10.7	11.7	11 9	18.7
Lumber and timber products	715,310	281,952	433,358	272,034	1,387,471	470,960	915,511	545,347	60.6	66.1	38.0	29.3	22 6	26 8
Lumber, planing mills products	307,672	184,227	123,445	79,945	500,438	299,266	201,172	120,513	40.1	40.2	26 0	24 1	14 1	16 1
Oil, cottonseed and cake	212,127	180,976	31,151	14,409	581,245	495,192	86,053	30,551	14.7	14.8	6.8	5.3	7.9	9.5
Paper and wood pulp	332,147	213,181	118,966	66,164	788,059	467,483	320,576	165,643	35.8	40.7	19.9	21.0	15.9	19.7
Petroleum, refining	396,361	325,266	71,097	27,290	1,632,533	1,247,908	384,625	116,369	18.0	23 6	6.9	7.1	11 1	16 5
Printing & publ., book and job	307,331	96,453	210,878	113,419	597,663	211,067	386,596	207,197	68.7	64.6	36.9	31 7	31.8	29.9
Printing & publ., newspaper	495,906	129,082	366,824	179,581	924,153	300,385	623,768	288,199	74 0	67 5	36.3	31 2	37.7	36.3
Rubber goods, other	223,611	126,112	97,499	43,906	987,088	525,686	461,402	231,756	43.5	46.7	19 7	23.5	23.8	23.2
Shipbuilding, iron and steel	66,217	29,270	36,947	28,752	1,456,190	643,753	812,737	595,631	55.8	55 8	43 4	40.9	12 4	14 9
Shipbuilding, wooden	22,465	9,327	13,138	8,938	165,872	66,770	99,102	66,927	58 4	59.7	39 9	40 4	18 5	19.3
Silk goods	254,011	144,442	109,569	57,615	688,470	388,469	300,001	134,597	43.1	43 6	22 7	19 6	20 4	21 0
Slaughtering and meat packing	1,651,965	1,441,663	210,303	89,697	4,246,291	3,782,930	463,361	269,175	12.7	10.9	5.4	6.3	7 3	4 6
Smelting and refining copper	444,022	379,157	64,865	19,767	651,102	584,410	66,692	31,620	14 6	10 3	4 5	4 9	10 1	5 4
Smelting and refining lead	171,579	154,015	17,564	7,630	196,795	179,374	17,421	11,281	10.2	8.9	4 4	5.7	5 8	3 2
Soap	127,942	88,867	39,076	14,780	316,740	238,519	78,221	35,100	30.5	24.7	11 6	11 2	18.9	13.5
Sugar refining	289,399	264,085	25,313	10,326	730,987	662,144	68,843	28,153	8.7	9 4	3 6	3 8	5.1	5 6
Tobacco, cigars and cigarettes	314,884	130,530	184,355	82,676	773,662	353,297	420,365	133,706	58 6	54 4	26 2	17 3	32 4	37 1
Woolen and worsted goods	379,484	246,497	132,988	86,500	1,065,434	665,595	399,839	199,090	35.0	37 6	22.7	18.7	12 3	18.9

TABLE 2. SHOWS FIGURES FOR ALL MANUFACTURING INDUSTRIES COVERED BY THE CENSUS STATISTICS

	Amount (000 Omitted)		Per Cent on Value of Products	
	1914	1919	1914	1919
Value of products	$24,246,436	$62,418,079	100.0	100.0
Cost of materials	14,368,089	37,376,380	59.3	59.9
Spread or margin	9,878,346	35,042,689	40.7	40.1
Wages and salaries	5,366,249	13,423,972	22.1	21.5
Balance to cover all other costs and profits	$4,512,095	$11,617,727	18.6	18.6

rate industry show remarkably similar percentages for the value added by manufacture in 1914 and 1919. This indicated advances in costs, wages, and gross margin, quite in proportion to the increase in value of their products.

The gross spread or margin for all industries was 40.7 per cent on the value of products in 1914, and declined only to 40.1 per cent in 1919. Wages and salaries advanced a little more slowly than prices, which was to be expected, but in almost the same proportion. In 1914 they were 22.1 per cent. Deducting this from the gross margin above leaves a balance to cover all other costs and profits which was the same for both years—18.6 per cent on the value of products. With the tremendous increase in the amount of business done as measured in dollars, naturally this balance for expenses and profits increased more than 2½ times in money or from 4.5 billions to 11.6 billions.

As general and overhead expenses do not ordinarily increase or decrease in proportion with sales it follows that the margin of net profits realized on sales in the later years was somewhat larger, and considering the tremendous increase in the amount of business done, the profits remaining for investors were very much larger sums of money. The larger profits of later war years are to be noted from the reports of practically all industrial concerns.

Changed Relationships in Readjustment Period

It is now realized that the relationships, ratios, and turnovers of pre-war and war times changed greatly during the readjustment period. That is always the effect of periods of readjustment. The losses sustained by businesses in such periods are caused by these relationships between costs and values of products being out of normal proportions. Wholesale prices fell abruptly on an average of about 40 per cent. Industrial activities slackened and the volume of production became less. Wages and salaries reacted more slowly. Overhead expenses increased out of all normal proportions to the volume of business done. Competitive conditions were very unsatisfactory. All of these things are evidences of the period of reaction. They are incident to such periods and are reflected in changed relationships, ratios, turnovers, etc.

The last two years, 1922 and 1923, have seen a substantial recovery of business and more normal conditions and relationships established. These are, in many cases, substantially different from the standards of earlier years and it is apparent that the normal relationships of individual industries in the future may be quite different from those considered normal in pre-war times.

It is unfortunate that statistics such as the foregoing are not available annually to enable a more complete analysis of the trends of business affairs. They would be of vital interest and of material assistance in the conduct of business. The trends from 1919 to 1921 and the changed ratios and relationships in various industries may be noted from published statistical compilations.[1]

Characteristic Margins and Expense Ratios

Table 2 shows some striking contrasts in the characteristic margins and expense ratios prevailing in different industries. Some have wide margins to work on between buying and selling prices, while other industries customarily operate on a narrow margin. In industries a very large portion of the value of products is absorbed by wages; in others only a relatively small portion. Some of the outstanding contrasts may be noted from Table 3:

TABLE 3. SHOWS SOME OUTSTANDING CONTRASTS IN CHARACTERISTIC MARGINS AND EXPENSE RATIOS IN DIFFERENT INDUSTRIES

	Per Cent Margin Added by Mfg.		Wages Per Cent to Value of Products		Per Cent Other Expenses and Profits to Value of Product	
	1914	1919	1914	1919	1914	1919
Businesses With Wide Margin Added by Manufacturing:						
Agricultural implements	55.2	52.6	29.0	29.1	26.2	23.5
Brick and tile	68.6	67.7	48.2	45.2	20.4	22.5
Cash registers	87.0	87.0	38.0	31.7	49.0	55.3
Chemicals	48.4	50.6	19.7	22.1	23.7	28.7
Electrical machinery	54.9	57.4	32.6	33.7	22.3	23.7
Foundry and machine shops	58.6	58.6	37.9	35.1	20.7	23.5
Glass	62.6	65.3	44.9	38.7	17.7	26.6
Lumber and timber products	60.6	66.1	38.0	29.3	22.6	26.8
Businesses With Narrow Margin Added by Manufacturing:						
Butter	12.7	11.8	5.8	4.9	6.9	6.9
Iron, steel and blast furnace	16.7	21.8	9.1	11.0	7.6	10.8
Flour and grist mills	14.2	12.4	4.7	4.0	9.6	8.4
Oil, cottonseed and cake	14.7	14.8	6.8	5.3	7.9	9.5
Slaughtering and meat pkg.	12.7	10.9	5.4	6.3	7.3	4.6
Copper smelting and refg.	14.6	10.3	4.5	4.9	10.1	5.4
Petroleum refining	18.0	23.6	6.9	7.1	11.1	16.5
Sugar refining	8.7	9.4	3.6	3.8	5.1	5.6

It is interesting to note from the foregoing statistics that from the point of view of the cost of materials and the value of products the slaughtering and meat-packing industry is the largest in the country. The gross value of their products for 1919 was $4,246,000,000, which was 6.8 per cent of the value of all products turned out by all manufacturing industries in the country. It is also noteworthy that this industry operates on a very narrow margin between cost of materials and sales value of product; in 1914 it was 12.7 per cent and in 1919, 10.9 per cent of the value of the products.

In passing it should be mentioned that the more

[1] See "Financial and Operating Ratios in Management," by J. H. Bliss.

important industries operating on narrow margins between costs of materials and value of product are those which produce major products and by-products or produce joint products. This should be borne in mind as affecting the methods of cost finding and the type of income statements which should be most appropriate.

Reference is made particularly to the following industries:

Flour and grist-mills
Cotton-oil crushing and refining.
Slaughtering and meat-packing
Copper smelting and refining
Sugar refining
Petroleum refining

In each of these industries the operations produce joint products of major products and by-products. The processes are a breaking up of materials into several parts as distinguished from the usual type of manufacturing operation, which is the building up of materials into a finished product. The operations in these industries are in this manner the reverse of ordinary manufacturing operations.

The Census reports also show statistics on the amount of capital employed in various industries. These figures considered in connection with the value of the products of the various industries give some indication of the wide differences in the turnover of various industries.

Table 4 shows for the same industries reported in the previous table, the value of the products and the amount of capital used. The turnover is also stated as the dollars of sales per year, per dollar of total capital employed. The capital here stated includes both current and fixed investments, that is, all funds employed in the business.

There may be some weaknesses in the compilation of these statistics as pointed out in the Census report. Obviously it would be quite impossible to get accurate figures for all of the various industries. However, as the purpose is only to illustrate the wide differences in turnover between them this element of error may be overlooked with propriety. The comparisons are very interesting and sufficiently sound to illustrate the point.

The average turnover and the trend as indicated by the totals for all industries are noteworthy. They are:

	1914 *Billions*	*1919* *Billions*
Value of products	$24.2	$62.4
Capital used	22.8	44.7
Dollars of product per dollar of capital	1.06	1.40

That is to say, all manufacturing industries in 1914 had on the average, sales of $1.06 for each dollar of total capital used in the business, and in 1919 had sales of $1.40 for each dollar of capital used. This improvement in turnover is significant and was to be expected with the conditions prevailing during those years. It does not necessarily indicate a better turnover of inventories or accounts receivable or other current investments, but probably is largely the result of the greater money volume of business done on the fixed investment in plants and facilities.

Considering the conditions prevailing between 1914 and 1919 industries naturally averaged somewhat better turnovers of accounts receivable and inventories, but as both of

TABLE 4. STATEMENT COMPARING, FOR DIFFERENT INDUSTRIES, THE VALUE OF PRODUCTS AND CAPITAL USED

Data from Abstract of Census of Manufacturers, 1914 and 1919 (000 omitted)

Industries	Value of Products	Capital Used	Value of Products	Capital Used	Dollars of Product Per Dollar of Capital Used	
	1914	1914	1919	1919	1914	1919
All Industries	$24,246,435M	$22,790,979M	$62,418,079M	$44,688,093M	$1.06	$1.40
Agricultural implements	$164,086M	$338,532M	$304,961M	$366,962M	$0.48	$0.83
Auto bodies and parts	129,601	94,854	692,171	470,498	1.36	1.47
Automobiles	503,230	312,876	2,387,903	1,310,451	1.61	1.82
Boots and shoes	501,760	254,591	1,155,041	612,625	1.97	1.88
Bread and other bakery products	491,893	271,262	1,151,896	529,266	1.82	2.18
Brick and tile, terra-cotta, etc	135,921	279,860	208,423	355,848	0.49	0.59
Butter	243,379	59,625	583,163	162,302	4.08	3.59
Canning fruits and vegetables	149,175	98,738	402,243	223,692	1.51	1.80
Cars and shop cons. & rep. steam railroad	514,041	354,092	1,279,235	694,286	1.45	1.84
Cash registers	30,520	41,075	83,539	82,798	0.74	1.01
Cement	101,756	243,485	175,265	271,269	0.42	0.65
Chemicals	158,054	224,346	438,659	484,488	0.71	0.91
Clothing, men's	458,211	224,050	1,162,986	554,147	2.05	2.10
Clothing, women's	473,888	153,549	1,208,543	390,527	3.09	3.09
Cotton goods	676,569	867,044	2,125,272	1,853,100	0.78	1.15
Electrical machinery	335,170	355,725	997,968	857,855	0.94	1.16
Fertilizers	153,196	217,065	281,144	311,633	0.71	0.90
Flour and grist-mill products	877,680	380,257	2,052,434	801,625	2.31	2.56
Foundry and machine-shop products	866,545	1,246,043	2,280,251	2,104,981	0.70	1.09
Glass	123,085	153,926	261,884	215,680	0.80	1.21
Knit-goods and hosiery	258,913	215,826	713,140	516,458	1.20	1.38
Iron and steel, blast furnace	317,654	462,282	794,467	802,417	0.69	0.99
Iron and steel wk's. & roll'g mills	918,665	1,258,371	2,828,902	2,656,518	0.73	1.06
Leather	367,202	332,180	928,592	671,342	1.11	1.38
Lumber and timber products	715,310	916,574	1,387,471	1,357,992	0.78	1.02
Lumber, planing mills products	307,672	266,805	500,438	361,848	1.15	1.38
Oil, cottonseed and cake	212,127	118,073	581,245	203,457	1.80	2.86
Paper and wood pulp	332,147	534,625	788,069	905,795	0.62	0.87
Petroleum, refining	396,361	325,646	1,632,533	1,170,278	1.22	1.40
Printing and publ., book and job	307,331	247,282	597,663	446,555	1.24	1.34
Printing and publ., newspaper	495,906	384,715	924,153	614,045	1.29	1.50
Rubber goods, other	223,611	199,183	987,088	782,638	1.12	1.26
Shipbuilding, iron and steel	66,217	132,712	1,456,490	1,268,640	0.50	1.15
Shipbuilding, wooden	22,465	23,348	165,872	120,808	0.96	1.37
Silk goods	254,011	210,072	688,470	532,732	1.21	1.29
Slaughtering and meat-packing	1,651,965	534,274	4,216,291	1,176,481	3.09	3.61
Smelting and refining						
Copper	144,022	171,420	651,102	308,680	2.59	2.11
Lead	171,579	143,249	196,795	115,677	1.20	1.70
Soap	127,942	92,872	316,740	212,417	1.38	1.49
Sugar—refining	289,399	140,500	730,987	193,541	2.06	3.78
Tobacco, cigars and cigarettes	314,881	171,982	773,662	416,395	1.83	1.86
Woolen and worsted goods	379,484	389,653	1,065,431	831,695	0.97	1.28

these classes of investments would increase or decrease as price levels advanced or declined the improvement in turnover would not be as large as in the case of the turnover on fixed property investment. This is so because higher price levels for products would show a higher turnover figure on property investments, without a proportionate increase in physical volume.

The increase in the amount of capital used is very significant, 1919 being practically double that of 1914. Note also that it is distributed over practically every important industry represented. It is unfortunate that we are unable to determine from available statistics how much of this increase is in current investments which were expected to contract as prices fell and how much of it is due to increased investments in plant and equipment which are permanent and will add fixed expense burdens to business.

More recent reports of representative companies indicate very substantial reductions in the amount of capital tied up in inventories and accounts receivable. As these investments are current they naturally respond to price movements and in addition may be controlled —must be controlled—if proper turnovers are to be maintained. Fixed property investments, on the other hand, are permanent and cannot be reduced as volume of business drops off. These conditions have brought about very substantial changes in the ratios, relationships, and turnovers apparent in financial reports, and indicate the establishment of new normal standards and relationships.

Contrast in Turnovers

The foregoing table (Table 4) presents some very interesting contrasts in turnovers, characteristic of different types of industries.

Table 5 shows some of the outstanding comparisons:

The significance of these differences of turnover must not be overlooked. If a business turns over its total investment once a year and desires to make a return of 6 per cent on its total investment, obviously it must average an operating profit of 6 per cent on its sales. If, on the other hand, the sales of a business for a year are three times the total amount of capital used, a margin of operating profits of only 2 per cent would yield the same 6 per cent return on the total investment used.

From the foregoing comparison it will be observed that the turnover in sugar refining and meat-packing industries is three to four times as fast as the turnover in iron and steel and fertilizer industries. This indicates that the two latter industries would require a margin of profit on sales three to four times larger than the sugar and meat-packing industries in order to yield the same return on the investment used.

To emphasize further the point that financial and operating ratios are characteristic of various industries, the following Table 6 is given

TABLE 5. SHOWS SOME OUTSTANDING COMPARISONS IN TURNOVERS CHARACTERISTIC OF DIFFERENT TYPES OF BUSINESS

	Dollars of Sales per Year Per Dollar of Total Capital Employed.	
Business With Rapid Turnovers:	1914	1919
Sugar Refining	$2.06	$3.78
Slaughtering and Meat-Packing	3.09	3.61
Butter	4.08	3.59
Women's Clothing	3.09	3.09
Bread and Bakery	1.82	2.18
Businesses With Slow Turnovers:		
Cement	$0.42	$0.65
Brick and Tile	0.49	0.59
Paper and Wood Pulp	0.62	0.87
Fertilizer	0.71	0.90
Iron and Steel and Blast Furn.	0.69	0.99

showing, for several of the more important industries, the ratios of profits earned on sales and net worth, and the turnovers, for the year 1920.[2]

A review of the statistics of other years shows the same characteristic differences in these financial ratios between various industries. Of course the trends from year to year may differ somewhat, due to difference in business conditions, but this only emphasizes further the point that these measures and ratios are characteristic of various industries and are to be noted in the analysis of financial statements.

It should be borne in mind whenever considering these ratios and relationships that the effect of any unfavorable ratio may be to reduce the surplus net profits earned on stockholders' investments. That is, a poorer turnover of inventories than average, or a subnormal turnover on fixed property investment is a handicap to a business in meeting competition and earning the average competitive return on its investment, and the effect of such subnormal turnover may be translated directly into terms of forfeited profits.

[2] From "Financial and Operating Ratios in Management," by J. H. Bliss.

TABLE 6. STATEMENT SHOWING RATIOS OF PROFITS AND TURNOVERS REALIZED BY REPRESENTATIVE COMPANIES IN VARIOUS INDUSTRIES FOR THE YEAR 1920

Industries	Surplus Net Profits		Days Sales in Accts. Receivable	Dollar Sales per Dollar Inventory	Dollar Sales per Dollar Plant Investment	Dollar Sales per Dollar all Assets
	Per Cent on Sales	Per Cent on Net Worth				
Auto and truck manufacturers	7.2	11.7	$0.30	$3.10	$2.78	$0.99
Auto accessory manufacturers	5.3	4.0	0.21	4.01	4.09	1.26
Bituminous coal	18.9	7.5	0.93	13.52	0.35	0.27
Copper mining—smelting and refining	3.9	3.1	0.12	2.68	1.21	0.64
Cotton goods manufacturers	6.6	11.5	0.70	3.39	3.26	1.04
Electrical machinery manufacturers	6.2	10.7	0.95	2.51	4.85	0.85
General merchandising	*3.0*	*7.2*	0.11	5.84	13.45	2.10
Iron and steel manufacturers	8.8	7.5	0.50	4.71	0.76	0.52
Leather manufacturers	*20.0*	*15.6*	0.36	1.35	1.54	0.60
Machinery manufacturers	11.0	7.5	0.85	1.82	2.36	0.58
Mail order merchandising	1.3	2.6	0.61	2.48	7.88	1.15
Petroleum oil companies	19.5	15.3	0.42	2.23	0.92	0.50
Railway equipment manufacturers	8.2	9.2	1.07	4.06	1.77	0.73
Retail chain stores	4.7	7.9	0.2	6.87	9.03	1.40
Rubber and tire manufacturers	3.1	3.9	0.50	2.55	2.34	0.83
Slaughtering and meat-packing	0.3	1.5	0.48	7.59	10.03	2.26
Sugar production and refinery	17.0	27.3	0.18	5.55	2.12	1.07

Statistics taken from "Financial and Operating Ratios in Management."

Profitable Methods for the Small Factory

Organization of Departments and Functions

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658.16 Organization

A SURVEY of the industrial and engineering literature of the past decade would seem to justify a mistaken impression that the country's industry now centers exclusively about great manufacturing plants, and that the small factory has passed, long since, into the limbo of effete institutions. A visit to almost any industrial locality would appear to substantiate this impression, as the usual panorama is one of titantic factories, in sharp contrast to the small plant of one and two generations ago. The belief that the small factory has disappeared, or is fading from our industrial life is, however, a misconception, amply disproved by the United States Census figures for the year 1919.

At the Tenth National Convention of the Society of Industrial Engineers,[1] the small factory—its actual management needs, and the scanty attention that it has hitherto received—was the subject of considerable discussion. Excerpts from the opening address[2] of Joseph W. Roe, President of the Society, follow:

> From what we hear and read it would seem that our huge plants have swallowed American industry bodily, and that the small plants have gone the way of the tiny three-toed horse of geologic times. This is far from true. Out of 290,105 manufacturing establishments reported by the United States Census in 1919, there were only 1021, or less than 0.4 per cent which employed more than 1000 wage-earners; and only 2770, or less than 1 per cent employing over 500. There were 235,884, or 81.3 per cent, which employed 20 or under, but they represented all told only 10.3 per cent of the wage-earners, and an even smaller percentage of the production. Most of this latter group are too small to be thinking of organization and production methods. The remaining plants, however—namely, those employing between 20 and 500 wage-earners—number 51,451, or 17.7 per cent of the total, and they represent 50.1 per cent or just over one-half of the total wage-earners. The figures for the value of the products are not given on the same basis, but a rough comparison is indicated by the fact that about two-thirds of our manufactured products come from establishments having an annual output of one million dollars or over, and about one-third from those with an output between twenty thousand and one million dollars. The moderate-sized plants, therefore, represent about one-half of our working force, and about one-third of our production, which means that their day is by no means over.
>
> These statistics coming, as they do, vested with high authority, emphasize the economic importance that factories with total personnels of 500 or less actually bear in their relation to the industrial life of the nation. If 50.1 per cent of our industrial workers, and one-third of our total production are involved in these smaller plants, we cannot afford to ignore them in the forward march of scientific management.

In undertaking a series of articles on the application of modern methods to the management problems of small plants, I am inspired partly by the fact that I have been able to find little or no printed matter on this subject, and partly by a realization of the potential value that such a series might have. This realization is the result of an experience of several years actually spent in a small, and in a medium-sized plant, following closely on an experience of many years in large factories. During this period it has been gradually borne in upon me, that (1) There is no principle of management applicable to the large plant that may not be applied with equal advantage and profit to the small one; and (2) that the introduction of modern methods in a small or medium-sized plant can usually be accomplished with greater facility and less expense than would be the case in a large organization. The latter is due in great measure to the ease of personal contact at all points in the small plant, and to the absence of red tape from its administration.

Special Fields of the Small Factory

The small factory has two definite fields, and there is no evidence that these are not permanent, or that the large plant is in any degree encroaching upon them. The first field includes those industries featuring quality in the product rather than quantity or volume of output. In this general class may be included the manufacture of jewelry, electroplated ware, decorated ceramics, mirrors, art-glass, certain optical products, leather goods of high quality, novelties, cabinet-ware, some forms of electrical apparatus, precision instruments, engineering supplies, and many other kindred or similar lines. In the second field are included those industries which operate to meet a local or community demand, such as bakeries, ice-cream and beverage factories, laundries, dye-works, etc. In the first of these fields, that of quality, the small factory is able to compete advantageously by virtue of its smallness. It is easier to keep paramount the spirit of quality in a small or medium-sized organization because of the closeness and personal character of its management. In the second, or community field, the small factory enjoys a virtual monopoly, and is concerned only with competition from other small plants.

[1] Held in Cincinnati, April 18-20, 1923.
[2] Reviewed in *Management Engineering*, May 1923.

In addition to these two clearly defined fields, there is an extensive and diversified range of products, not susceptible to classification or grouping, and which might in their nature, be manufactured by either large or small factories. In this nondescript class are included garments, bleached textiles, soap and perfumery, miscellaneous leather goods, books and stationery supplies, musical instruments, electrical parts, universal joints, gears, and an endless variety of other products. In summing up this more indefinite range, it can be stated that in addition to the fields of quality and of local or community demand, small and medium-sized plants are actually competing with large plants in the manufacture of all products which are not inherently of a monopolistic character like the telephone and its auxiliary equipment; or which are not produced with greater advantage and economy by mass or quantity production methods, such as steel, sugar, and oil. In the two latter fields—the monopolistic and that of quantity production—large factories are secure in their dominion.

Small factories abound in all industrial sections of the country, and may be found flourishing equally in the shadow of the textile mills of New England, in the smoke of the Pittsburgh steel industry, or beside the automobile plants of Michigan. In Metropolitan New York they are as ubiquitous as sparrows, occupying one or more floors in the innumerable factory and loft buildings of Manhattan, Brooklyn, and Metropolitan New Jersey. The writer has recently assisted in the reorganization of a small factory, engaged in the manufacture of high-grade mirrors, situated in the heart of New York's West Side. This concern occupies four floors of an eight-story loft building, and leases the remaining space to a bookbinding and publishing house. It includes as its near neighbors: another mirror factory; a packing house; a piano factory; a bottling works; a brush factory; a cooperage; an autotop factory; a paper mill; an electroplating plant, and a paint factory—all flourishing on a small scale within the confines of a single city block.

Differences Between Large and Small Factories

Before proceeding further it might be well to establish just what is meant by a "small factory." For reasons which follow, factories ranging from a total force of 50 up to a personnel of about 500 are selected, the average striking at plants with a total personnel of from 200 to 300.

The minimum of 50 is based upon the fact that in the majority of cases, factories smaller than this are too diminutive to be contemplating the installation of comprehensive management methods. Some of the elements of modern management may be installed in these very small plants. It is hard, for instance, to conceive of a factory so small that it could afford to be without some form of cost system, but unless a plant is turning over a volume of work sufficient to keep 50 operatives employed, it is doubtful whether the advantages resulting from new methods would warrant the expense incidental to their introduction. This does not mean that the principles of modern management do not apply to the very small factories, but rather that the application is so simple and obvious as to render unnecessary any special mechanism of management. They should all, however, have adequate cost systems.

In establishing a personnel of 500 as the high limit, it is desirable that we consider briefly some of the fundamental differences between large and small plants.

Dean Kimball [3] has featured division of labor as one of the oldest and most basic principles of production, and has shown the development of this principle to be an outstanding phenomenon in the growth and expansion of any industry. The inherent difference between large and small factories could be said to lie in the extent to which this principle has influenced the character and form of their respective organizations.

The Master Craftsman

The manufacturer of two centuries ago was a master craftsman, with a small workshop similar, in most cases, to a good-sized carpenter's or cobbler's workshop in our day. His capital consisted of this shop, some primitive equipment, and a supply of material upon which to work. Very frequently this material did not belong to him, but was supplied by a middleman. His working force included some journeymen skilled in the craft, and a few apprentices, the journeymen usually providing their own tools. Obviously, in this simple establishment, the master-craftsman was in close personal touch with every phase of his business, directing the work of his small force in such a way as to infuse the spirit of his own skill and experience into the quality of the article that he labored to produce.

He was usually illiterate, and the few records that he kept were of an extremely crude character. Periodically he loaded the output of his shop on a barrow or cart, and transported it to a nearby market, where he either sold it for cash or bartered it for necessary merchandise. Frequently the exchange was negotiated on the basis of some cash and the balance in merchandise. With what he was able to realize, he returned to his workshop, paid the journeymen their wages, and interred his profits in a strongbox. This was the era of handicraft methods, workshops, and a strongly personal type of management. A dominating characteristic of this period was the fact that the journeyman, working at his bench, produced a finished article, performing all the operations essential to its manufacture.

With the introduction of machines, following the invention of the steam engine in 1769, this characteristic began to disappear. Different machines were developed to accomplish different operations, and the manufacturing stages were soon distributed over a number of machines, or over a combination of machines and work-benches. As factories increased in size, with increased possibilities of production, this division of labor became more pronounced, until a point was gradually reached when an article passed through many hands and an equal number of manufacturing stages, in its journey from raw material to finished product.

The principle of division of labor was manifest, also, in its influence upon the character of management in

[3] "The Organization of Modern Industry," MANAGEMENT AND ADMINISTRATION, July 1923, p. 17.

the growing factories. The master-craftsman of handicraft times was in close personal touch with all the details of his small business and could move about with ease in his workshop, directing, criticizing, and teaching his group of journeymen and apprentices. With the introduction of power-driven machines, the details of management became proportionately more numerous, and with the steady increase in the size of factories, their multiplication continued, so that the master-craftsman—or, more properly, one of his descendents—in time found himself unable to take care of them single-handed.

New and complex problems, non-existent in the early workshop days, now claimed his attention. With increased production came larger transactions which must needs be financed and adequately recorded. New markets for the increasing output had to be developed and maintained, and he now had a salesman or two traveling by stagecoach to nearby and distant towns. New sources of raw material supply must be found and tapped. With an increased force of workmen came the necessity for systematically recording wage disbursements. The purchase of fuel for the power plant was an added detail. Other details grew out of the necessity for keeping machines in a state of repair. So the proprietor, in turn, was forced to divide his labor. He did so by selecting experienced workmen, and installing them as foremen in charge of the various stages of manufacture. The recording of transactions and of wage disbursements was centered in a factory office, and the proprietor now exercised a function of general supervision over these intermediate functions which obtruded between himself and the actual performance of manufacturing operations. In addition to this general supervision of the factory, he assumed responsibility for the financial status of the business, and personally directed the marketing of the product.

Impersonal Character of Management

It will be readily seen that division of labor had the effect of rendering the character of management impersonal and indirect, instead of personal and direct as it had been in handicraft days. Each delegation of responsibility on the part of the proprietor set him farther back from his firing line or performance line. Each new proxy that he placed between himself and his working force, rendered his position in regard to the workmen more remote, until, with the continued growth of plants to the proportions that the largest of them now assume, management has tended to become purely impersonal, and large organizations have assumed, somewhat, a bureaucratic character.

The basic difference between small and large factories could thus be said to lie in the extent to which division of labor is apparent. As plants increase in extent, functions are multiplied and management becomes remote, indirect, and impersonal. The reverse is true in the case of small factories. Functions are fewer and concentrated, and the management is of a personal character, and more in the nature of a reversion to the handicraft period.

While division of labor is apparent as factories range upward from a working force of 50, to a total personnel of 500, the "small factory" characteristics are not lost within this range. After plants pass the 500 mark, functions multiply, and the personal touch is noticeably lost. For this reason, the marginal high limit for small factories has been set at this figure.

In applying modern management methods to small factories, the fact must never be lost sight of that the problem is in miniature. While every principle of management applicable to a large organization is fundamentally applicable to a small one, the application in the latter case is necessarily in the nature of an adaptation in concentrated form. The fundamental differences between large and small factory organizations could be broadly stated somewhat as follows:

1. Management in the large factory is remote and impersonal in character, while in the small factory it is relatively closer, with the preservation of personal contact between management and workman.
2. Extensive division of work in the large factory leads to a multiplicity of functions, while the reduced size of the small factory, with reduced division of work, causes a relatively smaller number of functions, with several functions often vested in one individual.

Inadequacy of Management in Small Plants

It is a fact, unfortunately, that an impression somewhat prevails that the need for scientific management is not so pressing in small plants as in the larger ones, and also that the beneficial effects of good management are more apparent where the annual turnover is great. Both of these assumptions are incorrect. If a factory with an annual output of $3,000,000 is out of pocket $150,000 owing to a year of faulty management, and a factory ten times as small, for a similar reason sacrifices $15,000, the difference is only in the aggregate, the proportion in each case being the same, or 5 per cent of avoidable loss; and the small plant is usually less able to bear this loss, because it cannot, as a rule, command financial resources in the same degree as can a larger business. If a plant has a personnel of from 50 to 500—our small factory range—its need for the best and most modern type of management obtainable is just as urgent as would be the same need in a plant ten times or fifty times the size, and for the same axiomatic reason: *That in order to meet competition and still show a fair annual profit, and in order to weather dull periods and industrial depressions, efficient management at every stage is absolutely essential. The positions of both large and small plants in this respect are identical.*

The fact that our small industries have lagged behind in their acceeptance and adoption of modern methods is probably due, in great measure, to the fact that the pioneer work in this field was accomplished in large organizations. If F. W. Taylor had performed his notable Bethlehem experiments in a smaller plant, and had published his results on this basis, a host of similar plants would undoubtedly, by this time, have developed modern organizations and efficient methods, and the list of failures in this class during

the recent depression would not have been of such a discouraging length.

A second reason for this backwardness probably lies in the fact that the majority of small plants operate on a narrower financial margin than do the larger ones, and feel that they cannot afford to dissipate a slender reserve in refinements, the benefits of which they have not experienced and do not fully understand. As most of them are without cost systems they do not know, except in a general way, the comparative profit or loss from different lines of product, and for the same reason they are not in a position systematically to detect inefficiencies in the use of labor, materials, or machines. So, without the means of establishing their need for a different type of management, they drift along a haphazard course, until a book-closing at the end of a dull year reveals the startling fact that serious losses have been sustained, and that the concern is in a precarious financial position.

It is a safe assertion that the preponderance of small plants have no adequate system of determining monthly costs, distributing overhead expense, or making economic comparisons between various lines of product. Many of them are without stores control, and record their use of material and supplies in some crude and unsystematic way. A higher percentage have not realized the necessity for systematically scheduling and routing orders through manufacture. Few of them have any accurate idea as to the actual output capacities of their manufacturing equipment, and fewer have compiled standard output figures. A piece-work or bonus system is sometimes found, but in most of these cases there is little intelligent connection between the rates used and the output possibilities of the operations which they represent. Many small plants have no time-clocks, the weekly pay-roll being assembled from a penciled list, or from a book turned into the office by a foreman or gang boss.

This lack of intelligent control leads to varieties of inefficiency that verge, sometimes, on the incredible. A small factory in New York City, employing about 100 men, and engaged in the manufacture of cabinet-ware, had never installed a time-clock. The pay-roll was made up once a week from a list handed to the bookkeeper by the factory general foreman. One morning a workman, one of the regular employees, appeared at the office, and to the surprise of everyone, asked if he might be reinstated in his old job. According to the pay-roll record, this man was still in the concern's employ, and had each week received a pay envelope. His statement was that he had been dismissed some three months before, and that he would like to have another chance. An investigation brought to light the fact that the general foreman had discharged this man, but had continued turning in his name to the bookkeeper and each week had pocketed the contents of an additional pay envelope. The general foreman was at once dismissed and narrowly escaped arrest. The extent to which he may previously have mulcted the pay-roll will always remain a matter of conjecture.

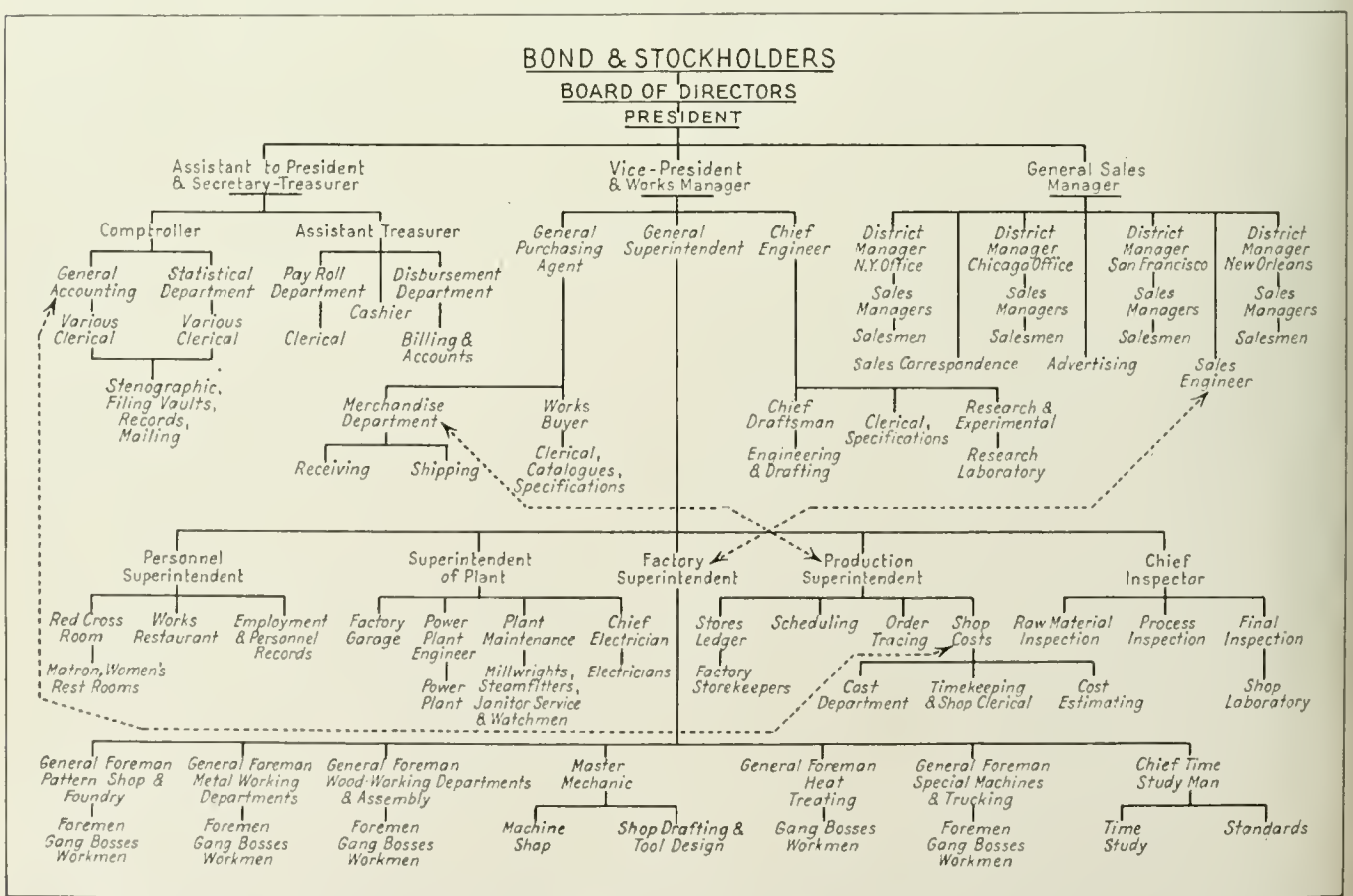

FIG. 1 TYPICAL GENERAL ORGANIZATION CHART OF A LARGE METAL AND WOOD-WORKING FACTORY WITH A TOTAL PERSONNEL OF ABOUT 3000. NOTE MULTIPLICITY AND DIVISION OF FUNCTIONS

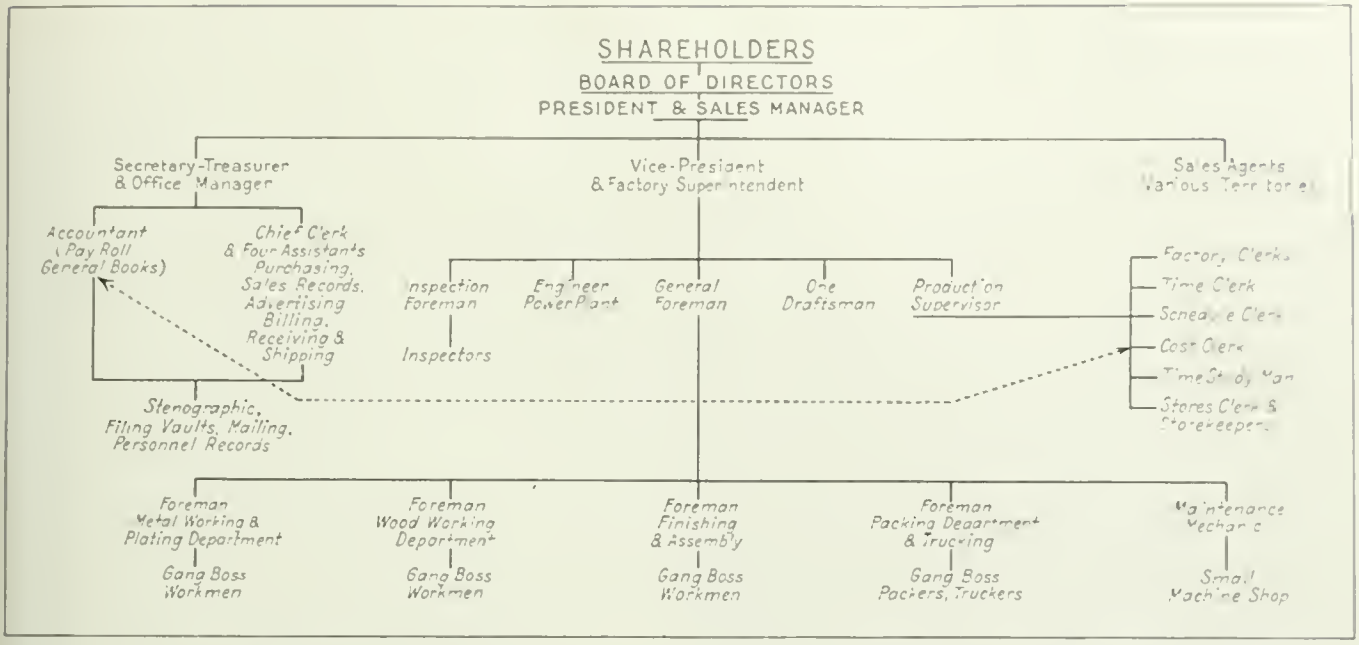

FIG. 2 TYPICAL GENERAL ORGANIZATION CHART OF A SMALL FACTORY WITH A TOTAL PERSONNEL OF FROM 200 TO 400. NOTE CONCENTRATION OF FUNCTIONS AS COMPARED WITH FIG. 1

A factory in Ontario, turning out a line of dairy equipment, was forced by a flood of defective parts, and of complaints from customers, to call to its aid a firm of industrial engineers. The president of this concern prided himself on his conservatism, and had always regarded the preparation of blue-prints showing standard machining limits, as a frivolous and unnecessary refinement. He maintained, instead, what he termed a "master-parts room," in which samples of all the component parts, machined accurately to size, were suspended from hooks. A workman wishing to set the index of his machine correctly, did so by comparing a roughly machined part with the supposedly correct master-part. A careful examination of the contents of the "master-parts room," brought out the interesting fact that most of the samples had been machined to wrong dimensions, and an explanation of this condition was finally vouchsafed by a frank workman from the assembly department. It appeared that in times remote, a lazy assembler, unable to fit a component part into a cream separator, had solved his difficulty by the simple expedient of substituting the master-part for the defective one, and vice-versa. This process worked so well that it was repeated, on later occasions with other components, until the character of the sample room was gradually changed to that of a junk-room. These revelations led to the hasty preparation and use of standard blue-prints showing high and low limits, a change which soon swept away the critical "defective parts" situation in which the management had been so helplessly floundering.

It has been seen that the inherent difference between large and small plants lies in the extent to which division of labor has influenced the character and form of their respective organizations, and that while the extensive application of this principle in the very large factory has led to a great array of functions, the reduced size of the small plant with less division of work, causes relatively fewer functions, with several of these frequently combined and vested in one individual. Also that while extensive division of labor in large plants has tended to render the management remote and impersonal, in small plants the personal touch is preserved; the spirit of the management, through personal contact and mutual understanding, having a better chance to permeate all parts of the organization.

Both of these characteristics give the small factory an advantage within its field of operation. As functions multiply, the bureaucratic bugbears of "red tape" and internal politics become apparent. Overhead expense is frequently higher. When management loses its personal character, also, it tends to become spiritless, a quality that will be quickly reflected throughout the organization. Compensating advantages, such as reduced unit cost from quantity production, must be very apparent in order to offset these disadvantages which are inevitable as organizations grow.

In Figs. 1 and 2 are reproduced two organization charts which illustrate the manner in which functions are distributed in a large manufacturing organization, and concentrated in a small one. Fig. 1 shows a metal and wood-working plant with a personnel of 3000 or thereabouts, and illustrates the extent to which the various executives are actually removed from the performance of the work that they direct.

In the second figure a plant of from 200 to 400, manufacturing a similar product, is represented. In this organization, two "small factory" characteristics are immediately apparent: (1) That the executive heads are relatively close to their performance lines; (2) that while most of the functions exercised in the large plant appear, they are greatly concentrated.

The president in the small organization is also the sales manager. The secretary and treasurer, in addition to his corporate function, assumes the rôle of office manager, directing the work of an accountant,

who keeps the general books and the pay-roll; and that of a chief clerk who does the purchasing, keeps the sales records, attends to the details of advertising, and with the assistance of four clerks, takes care of all general office routine.

The vice-president is also factory superintendent and is assisted by a small planning office from which stores control is exercised, orders scheduled in advance through manufacture, time studies directed, and monthly costs established. This department, with the addition of a draftsman, constitutes the vice-president's staff. His line organization, as indicated by Fig. 2, consists of a general foreman, five department foremen, five gang bosses, an inspection foreman, a power plant engineer and a maintenance mechanic.

It must be added that this chart is not typical of the majority of small factory organizations as they exist today, nor is it intended to be. It shows, rather, the organization of a plant that has fully realized and acted upon its need for the most efficient type of management obtainable. It is not in any sense empirical, but embodies substantially the organization form and functions of a small factory which the writer has recently seen very successfully reorganized.

"Line and Staff" in Small Organizations

In Fig. 2 a square encloses the various planning functions, which appear at the right-hand side of the chart. Within this square are most of the elements of management, the presence of which could be said to distinguish the scientifically managed small plant from the other type, in which scientific control is largely lacking. To this combination of functions, the vice-president turns to ascertain the nature and economy of past performance, and from the information thus gained, to determine and control present and future performance. This planning office comprises his staff, and if it properly fulfills its purpose, must establish how and when and at what cost manufacture is to be conducted, and it must be in possession of whatever methods and instruments are necessary to these ends. In proportion to the efficiency with which the staff element plans, so will the line organization—the general foreman, foremen, gang bosses, and workmen—execute, for in the respective meanings of these two words is contained the fundamental difference between the staff and line elements of an organization. The staff element plans, while the line executes or accomplishes this preconceived program.

Much has been written in recent years of these two elements in organization. Indeed, a history of industrial management during the past 30 years would be found to center very largely about the staff principle, and its proper adjustment to a multitude of industrial activities. This principle simply stated, is: that in order to attain a high level of efficient performance, the planning of work must be separated from its execution, and placed in the hands of experts specially qualified to perform this function. The executive element, or line, thus disburdened of the need for determining how and when work is to be performed, is left with proportionately more time and energy to devote to its actual accomplishment, the burdensome details of "how" and "when" having previously been taken care of.

The recent adaptation of this staff principle has gradually transformed the character of leadership in large plants. The manager of today, in this field, is an industrial Von Moltke, winning his victories by virtue of concerted staff knowledge, and the careful planning of details in advance so as to reduce to a minimum the possibilities of mishap or failure. His predecessor of yesterday accomplished results more dictatorially, but with less certainty, by the Napoleonic method of trusting to the loyalty, enthusiasm, and somewhat haphazard methods of a line organization. There is every indication that the staff principle, in its industrial application, is here to stay, and that it will develop a vastly wider scope in our organizations of the future.

And even as large industries have been found to function more efficiently and gain a higher productivity, when the planning of the work has been sepa-

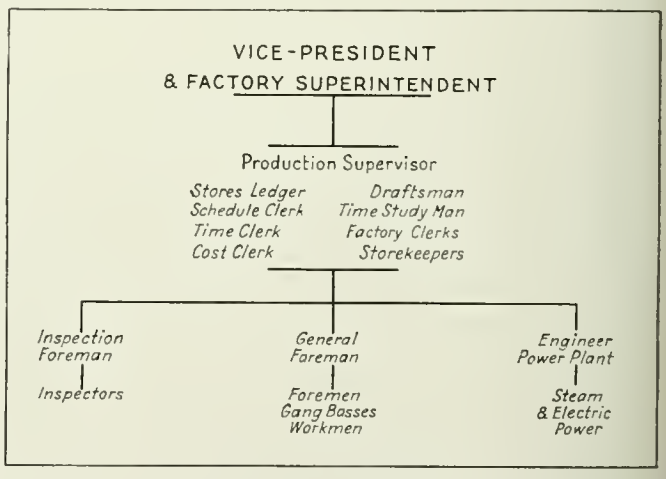

FIG. 3 LINE AND STAFF ORGANIZATION CHART OF MANUFACTURING DEPARTMENT FUNCTIONS IN A SMALL PLANT

rated from its performance, so do the small plants benefit by a similar recognition and utilization of this principle. For the staff principle is equally applicable in both cases, the only difference being in its manner of adaptation. Here, again, division of labor appears as the distinguishing factor.

There are few plants, within our small factory range, that are not continually confronted with problems that demand the expert staff knowledge of the chemist or engineer, and practically none that will not benefit greatly and increase their annual profit considerably, by wise utilization of the staff functions of production planning and cost finding. The small factory, with its closer management, is without need of most of the personnel and welfare activities by which large organizations are endeavoring to bridge the chasm that vast division of labor has created between management and workmen. This, however, is the only phase of staff activity that the small plant may readily dispense with.

In making adequate provision for staff functions, the problem is chiefly as to how they may be wisely and economically concentrated. It may, for instance, be expedient to vest several functions in one person, as in the case of a technical graduate who acts as produc-

tion supervisor, and at the same time develops the technique of manufacture. Or it may be desirable to merge staff and line functions in one individual, as in the case of a small plant manufacturing chemicals, where the superintendent is a chemical engineer, directing the work of foremen and workmen, and at the same time furnishing expert knowledge in regard to processes. It will be observed that in both of these examples, the staff principle is recognized, and then applied in such form as to be practicable.

The line and staff functions of the manufacturing department in Fig. 2 are shown again in Fig. 3. This chart shows the planning functions in a plant of from 200 to 400 personnel. It will be noted that the vice-president who is in active charge of manufacture, has, as his "chief of staff," a production supervisor, who in his turn directs the work of a stores clerk, a schedule clerk, a time clerk, a cost clerk, and a time-study man; also a sufficient number of factory clerks and storekeepers. A single draftsman who may report either to the production supervisor or directly to the superintendent, is also included. This is a reasonably typical planning office for factories of this size. If the plant is smaller, with a personnel of 100, or of 60, the functions may be concentrated proportionately.

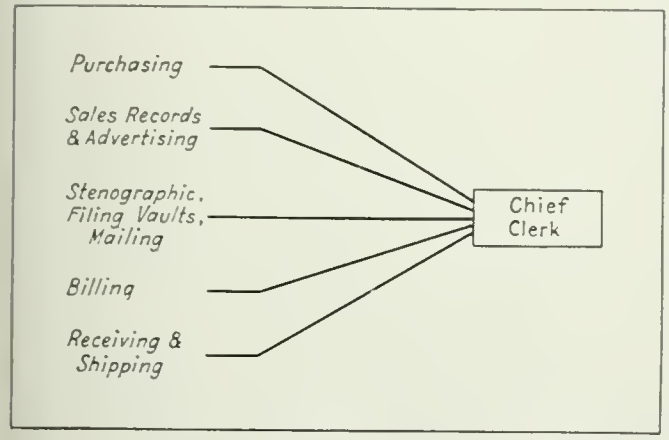

FIG. 4 DEPARTMENTAL ORGANIZATION CHART IN A SMALL FACTORY

In summing up the advantages to a small plant of a modern organization and staff methods, it might be said that these features, instead of being costly and burdensome, have, where properly utilized, proven economical, and have served to enhance the characteristic advantage that the small plant already possesses, and which the great factory has sacrificed. This is the preservation of relations between management and workmen that are personal and human. No amount of scientific organization, psycho-analysis of personnel or wholesale welfare work can duplicate the esprit de corps possible in a small industry. The addition of staff management, in so far as it gives the employer a closer and more accurate view of the workmen, serves only to accentuate his advantageous personal relation.

(To be continued in the March issue.)

Quality Habits That Were Transplanted 3000 Miles

By L. J. BELNAP

President, Rolls-Royce of America, Inc.

Index Number
658.562 Quality control
658.9:629.113 Automobile industry management

A FEW years ago we established in America a factory for making the Rolls-Royce car which had achieved an excellent reputation in England and the Continent, and we were up against the problem of reproducing the same high quality of product without interruption. What were the essential elements of quality, how could we transport them thousands of miles, and how could we teach them to new units of men? The problem involved a study of all the elements of quality in its creation, its perpetuation, and its improvement.

In July 1920, when we started building Rolls-Royce cars in America, business in general was in the doldrums. We were in the back-wash from the unprecedented peak of production brought about by war-time necessity. Many plants were either closed or were closing down. Workmen were idle or were anticipating being laid off. When machinists and mechanics were idle, we could have the pick of the lot. Naturally we chose the best.

The next thing was materials. In 1917 the parent company, in England, had sent over a picked staff of engineers to control and supervise the building of Rolls-Royce aero engines in this country. These engineers knew from experience where the highest quality of materials and workmanship could be secured. They knew, without loss of time, where the severe specifications which they insisted upon could be lived up to, and where it would be useless to expect them. That very competent staff, already familiar with American purveyors of material, is now our engineering division. Without this experienced corps of engineers and without the opportunity to pick our workmen at a time when we could afford to develop and train them in our methods and shop practices, it is possible that the Rolls-Royce economic opportunity would not have been within reach.

The location for the works, Springfield, Massachusetts, in the heart of the machine-tool and precision instrument district of New England, was selected because of the excellent mechanics who for generations have lived and worked in this section. Quality work requires, first of all, a real love of quality workmanship, and here such workmen were to be found.

Perhaps when F. H. Royce started the organization at Derby, England, it was not essentially better than others, but subsequently it had the advantage over the average organization of working and growing under the policy of absolutely the highest quality without restrictions. Whatever it was at the beginning, this

distinction must have ingrained itself into the organization. Its success did not, perhaps, prove the methods to be the only ones which would bring results, but it certainly proved this set of methods to be one dependable road to the achievement of highest quality. Unquestionably, a well-founded and well-deserved reputation rests upon real causes, clear purposes, and habitual methods, which insure character in organization and product.

A picked group of English workmen was brought over and mingled with the picked American mechanics. The entire organization entered into a spirit of friendly emulation to build a Rolls-Royce car in America as fine as one could be produced anywhere else in the world—better if possible.

Men were not enough, however. We must have habits. Working drawings and an entire set of parts of the car in all different operations and stages of completion were brought over from England. With the English supervisors, working drawings, and parts for comparison with American-made parts, we installed the best of the English methods and shop practices, those methods which had brought about the world-wide reputation of the car in the hands of owners.

The Value of Habits

We found ourselves in possession of traditions and habits which were quite as valuable, in their way, as the drawings and blue-prints of the car itself. The plant managers and superintendents recognize today the practical importance of traditional habits at the very establishment of the works. Consequently, each day we pay attention to grading up habits still further, for the sake of the future. That is the only way to secure future progress.

The whole organization, from manager to machinist, is responsible for quality. Without the energy and co-operation of the entire personnel, the manager is helpless. The chief duties of the manager are to give the organization the opportunity to find itself and fit itself together economically, to remove obstacles, to forestall interference.

The standard of quality was impressed upon all the workmen by a system of signs and notices. Blue-printed placards were placed in frames above individual machines, visible not only to the workman at that machine, but to all the workmen in that vicinity. These cards carried instructions and reminders, not only of the universal desire for quality, but of the detailed precautions necessary in manufacturing processes, without which quality will never be secured in the finished product. Inspectors have already inspected raw materials closely. But, "Inspect your own raw material before you start work on it. If it's not right, take it back to the stores," one big card tells the workman.

Another reminds him, "Every blue-print is accompanied by an exact model part from the English works. After you have made the first part, compare it with the model before making any more," and so on. This method went a long way towards establishing the policy of "Quality First".

But quality first does not mean that economy of operation and efficiency is lacking. Once the routine of shop methods and practice is established, then attention must be given to increase of output with decreased overhead expense. The purchaser is entitled to his money's worth.

During the last five years this country has acquired a great number of executives, many of them young but with an unequaled experience and initiative which could not have been acquired so quickly at any other time in the world's history. The country has not yet become aware of this permanent heritage of the war. But these executives, trained during the war, have been brought up with one bad habit—extravagance. They need to be re-educated in this particular.

Economy Necessary to Good Management

Many a man talks 25 or 30 min. with New York, at $15 a talk, when he could with a little intelligent management have transacted the business the day before by letter, at an expense of a few cents. This is rather different from the old days when an executive had to count the words in a telegram and turn in a postage slip at the end of the day. There is a happy medium ground between the two, but a harking back to the old practice is salutary, and intelligent management must recognize the necessity for economy.

In these days an important part of a manager's job is the repression of the expensive, extravagant impulses of the men working with him. But the repression must be constructive. A manager must be able to suggest, or inspire suggestion from someone else, of less extravagant means of accomplishing the desired result.

For instance, one of our foremen had an operation for which he wished to requisition a new and very fine lathe, costing about $3500. This lathe was larger than necessary to perform the work for which it was desired, but the foreman's contention was that it would be available for other work which could be done if we had the lathe. We had previously decided that the works were to be operated with the existing tool equipment, and that the output was to be increased each month with this same equipment, unless, of course, some real need for new equipment was experienced. Well, we eventually bought a lathe for $900 which does the work required of it very comfortably and satisfactorily. The tendency to buy equipment too large for immediate needs with the idea that it will take care of increasing operations and work outside of its immediate demands, is one that should be curbed in the interest of economy and efficiency.

The same principle holds good in the hiring of men. Frequently new men are hired for temporary jobs. These little jobs are coming up continually, and foremen hesitate to release any of the extra men, even though carrying them along increases costs and overhead. Practically any plant that really needs only 4000 men could keep 5000 men looking reasonably busy. The whole 5000, however, might not turn out as much product as the 4000 men working efficiently.

Our plant has now been running to capacity for two years, but we have not ceased, and never will cease, to study quality and economy in order to maintain and improve them.

Supplying Financial and Cost Information

What Should be Given to Department Heads?

By G. M. PELTON

Swift & Company

Index Number
Cost keeping 657.524
Financial control 658.14

HOW and to what extent department heads should be supplied with financial and cost information is a question of vital importance to present-day industrial and business concerns. It immediately raises the issue of the need for departmentization in business and industry, for the purpose of more satisfactorily delegating financial, operating, and merchandising responsibilities to department heads, particularly heads of merchandising departments and foremen of plant departments.

Irrespective of the type of organization, it is fundamental that the management of industrial concerns embraces three general functions:

1. Merchandising, that is, buying and selling.
2. Operating, that is, manufacturing and distribution.
3. Financial.

Of course, it is desirable in all concerns to have merchandising executives who exercise general supervision over the combined buying and selling operations. The buying and selling must be tied up and controlled from a broad and final point of view.

The members of the buying organization should be guided by costs which will tell them what they can afford to pay for materials and supplies. The selling department heads should be informed of their actual and total costs and results, so they may intelligently meet competition and properly handle their business. Operating is also a distinct function of the business, and heads or foremen of these departments should be regularly supplied with adequate cost information.

In many industrial organizations, departmentization is necessary because of the large variety of operations, the kinds of products handled, the various bases on which expenses should be distributed, and the cost problems encountered. Where an organization handles several lines of products, and may even engage in entirely distinct and competive industries, it is essential that its accounting procedure, cost finding, and departmentization should recognize the requirements of each line of business, and that each department should be accounted for on its own basis in the manner best fitting its operations and transactions.

This is clearly evidenced in our own industry in which there is highly specialized departmentization, and in which all three of the fundamental types of cost finding methods are used, i. e.:

1. Ordinary, such as job or process cost, wherein to a known amount of material is added a definite amount of labor and expenses, the sum total of which is the total cost.
2. Major and by-product cost, which involves the taking apart or breaking down of some materials of known value into several or many parts, of which one is the major product and the others by-products. This is the method of figuring cattle costs in the packing industry, the same method applying to other industries, such as petroleum, the production of many farm products, etc.
3. Joint product cost, pertaining to operations which are the breaking up of something of known cost into several or many parts, none of which may be termed the major product. This method of cost finding is used in tobacco, glue, cotton-seed oil, the hog business in the packing industry, etc.

To illustrate the necessity for departmentization and the different types of cost finding in our industry and business, we find that some plants handle only a cattle, calf and sheep business. Others may do only a hog business. Some will handle all classes of live stock. Some plants do not process by-products to any extent, but dispose of them raw, or in lesser stages of manufacture, while others process their products to various degrees. Some plants do not engage in allied industries, while others may have extensive operations in separate competitive businesses, such as fertilizer, glue, soap, etc.

The method of handling the business, in each case, and the accounting therefor, requires careful and logical departmentization, appropriate to the particular plant and its activities. Each department, or activity, meets the competition of other firms engaged in that particular line of business. In reality, each department is a separate business using its own capital, handling its own products, incurring its own expenses and being held responsible for its own final results, in competition with similar businesses. It is necessary, therefore, that each of these separate departments, or competitive businesses, be handled, operated, and fully and finally accounted for on its own independent commercial basis.

Operating departments as separate business units and accounting for them as such, requires that each carry its own investment in inventories, plant, and equipment, etc.; that each should be charged for its materials at full cost, or value, if received by transfer from other departments and be charged with all factory and general costs and expenses; and on the other hand that each department should receive credit for its

sales, or transfers of product to other departments, at full sales or market value. Naturally it is clear, then, that the departmental statement of each department is a combined financial, merchandising, and operating report of the department for each period.

Now, in any industry in which this situation prevails, two parties are directly and vitally interested in these statements, and the figures they contain—the operating man, who is directly in charge of the plant department, and the selling department head, who is directly responsible for the merchandising transactions. Indirectly, the plant manager, superintendent, buyers, financial and other general executives are interested in these figures. It should be recognized, however, that we are now looking at this question from a departmental standpoint, and assume that general executives will be fully supplied with statistics and information.

Let us now consider the cost information to be submitted to these three classes of department heads:

1. Costs for use of those who handle buying.
2. Costs for plant operating department heads.
3. Costs for selling department heads.

To get the best results from the buying viewpoint, it is necessary to supply the buying organization promptly and regularly with cost information indicating what the selling prices of finished products will permit of paying for raw materials. The prices at which goods will sell necessarily limit the prices which can be paid for materials and ingredient supplies. In some businesses, it is possible to figure up the cost of a product, and from that cost to determine a selling price. That is commonly thought of as the purpose of cost accounting, namely, to establish the basis for determining selling prices. That is a very fallacious notion as applied to most competitive manufacturing businesses, for the reason that the real function of cost and the real service performed in cost finding is in the determination of the maximum which can be paid for materials, rather than what may be charged for the finished products.

To think that in the average industry the cost determines the selling price, is cocking one's economic hat on the wrong ear. It works just the other way. The whole question lies in the satisfaction of human desires —that is, the determination of what people want, when they want it, where they want it, and how they want it, which are generally recognized as the utilities of time, place, and form. In order to continue doing business for any considerable length of time it is necessary to meet these requirements. That is, supply has to be adjusted to demand, not demand adjusted to supply. The problem is: What are the finished products selling for and what is the maximum price that may be paid for the raw materials?

Now, as to costs for plant operating department heads, it is obvious that statistics on the cost of manufacture and operating efficiency are the means of guiding plant operations and maintaining proper standards of quality and efficiency. Two things are fundamental in connection with plant operations:

1. The handling or manufacture of products in the most satisfactory manner to meet competitive standards.
2. The performance of this service at the lowest cost and expense.

Do not overlook the fact that competition is met in every detail of plant operations and costs. Every saving made in a plant operating department is reflected in the final net results of the department and the business as a whole.

Merchandising men, or department heads, must, of course, have costs if they are to be in position to handle their transactions intelligently and profitably. They are interested in all elements entering into costs, that is, financial, operating, and merchandising elements, and should have constantly at hand summary information showing final costs, compared with their selling prices indicating to them the margins of final net profits their daily transactions are showing.

The methods by which detailed and departmental cost information may be supplied to the departments, or employees in charge of, and responsible for, the various functional activities of an industry, vary. They depend on the nature of the operations, the kind of products handled, and the particular information required in each case.

Types of Cost Information Needed

As already pointed out, different types of cost information are needed by those who are responsible for the proper administration of the buying, production, and selling functions of a business. And the kind of cost information needed by each varies in different industries, and in different businesses within a given organization. In a broad sense, however, granting that these specific kinds of cost information are desirable, the primary purposes of all costs are: (1) To assist in obtaining efficient management of a business in competition with other similar businesses; and (2) to aid in securing the best possible final net results on the invested capital.

But, important as it is to have correct cost figures, they are of little or no value in the administration of any business, unless proper use is made of them. The point is, that in every activity of any business, and in every department, it is the specific and direct application and use made of cost data that is of value. And this must be done in the light of other factors affecting the business, such as the supply and availability of raw materials; the demand for the manufactured products, the operating, merchandising, and financial facilities of the company; requirements in meeting competition; seasonal products, and general business changes, etc.

To illustrate: In our own industry and business the methods and scope of supplying cost information, and the uses made of it are somewhat as follows:

1. General executives of the business are informed of and use merchandising, operating, and financial costs; in fact, all costs relating to the business as a whole.
2. Merchandising department heads receive and use all costs pertaining to their departments.

3. The buying staff uses cost information indicating what the selling prices of finished products will permit of paying for raw materials. They are interested in knowing the quantity and kinds of finished products demanded by the trade, the stocks on hand, the livestock receipts, etc. Live animals are usually purchased by quality and weight, and dressed costs and yields are usually determined by lots, as purchased. The dressed costs, yields, and current selling prices prevailing, compared with the live costs, indicate what the buyers can afford to pay for live animals.
4. Operating men, such as superintendents, division superintendents, and foremen, each receive and use the kind of cost information which indicates the efficiency obtained in handling the operations for which they are held responsible. A superintendent uses cost figures and statistics covering total plant operations. Each division superintendent is similarly supplied with and uses production figures and statistics applying to his particular division of the plant. Foremen of the plant departments are furnished detailed and total costs of their departmental operations, exclusive of gross and final results; and by using summary and detailed comparative statements of these costs, they are in a better position to handle their operations intelligently and economically.

Of course, it is recognized that the departmental method of accounting is not used in all kinds of industrial organizations, many of which might be able to use it to advantage. Many concerns summarize their production operations, that is, costs of materials, labor, and factory expenses, on job tickets or cost sheets. Consequently, the identity of the separate elements of cost of goods manufactured is lost in many cases, as is also the opportunity for securing a complete and detailed accounting for the merchandising, operating, and financial transactions applying to the particular classes of products. The production cost figures are buried in the cost of goods manufactured, and nowhere is there a general summarization of the combined detailed production, merchandising, and financial cost figures. There are at least two fundamental disadvantages in connection with this plan:

I. General executives and also heads of merchandising and operating departments do not get a connected and comprehensive accounting, from a complete business standpoint, for each class of products handled or kind of business done. That is, the information is supplied to them on a piecemeal and disconnected basis, thereby practically eliminating the possibility of making complete and satisfactory analyses of the figures and statistics for the purpose of drawing proper conclusions.
2. It does not permit of adequate distribution of responsibilities to heads of operating and merchandising departments, and proper supervision from the general executive management.

A departmental statement, on the other hand, if properly prepared, contains full and complete information covering the financial, cost, and merchandising operations and results of each department, i. e.:

1. It contains a record of the sales and the cost of goods sold. This permits of determining the gross or merchandising results.
2. It shows such information as the product gains, shrinks, and yields, total expenses, itemized by groups—that is, those of a direct, indirect, fixed property, and administrative nature.
3. It shows the final net results obtained before and after deducting operating interest, consisting of:
   (*a*) Interest paid on borrowed money.
   (*b*) Federal taxes.
   (*c*) Dividends due and payable to stockholders, etc.
4. It indicates the amount of capital, such as land, buildings, machinery, inventories, and accounts receivable used in conducting the business of the department.
5. It contains cumulative figures to the first of the current period, covering gains, shrinks, yields, costs, expenses, results, etc.

In short, it is a combined financial, operating, and merchandising statement indicating whether a department is operating efficiently or inefficiently, and what, if anything needs to be done to bring improvements.

In financing the average business the following factors, among others, have to be considered:

1. That the stockholders or proprietors invest their money in the capital stock of the company for the purpose of obtaining a fair return on their money. This return is represented by dividends paid on the capital stock issued and must be paid out of surplus net profits earned.
2. The bondholders invest their money in bonds issued for the purpose of obtaining interest on the money they loan. Similarly, the holders of current notes payable are entitled to interest for money loaned by them.
3. Surplus indicates the accumulative profits or money retained in the business after:
   (*a*) Expenses and costs have been met.
   (*b*) Interest has been paid on all borrowed funds.
   (*c*) Stockholders have been paid their dividends.

The secret of successful financing from this point of view is to use the least possible capital consistent with properly financing and conducting the business. Idle capital is a burden to business. It produces interest costs and overhead expenses for which no value is received. This emphasizes the importance, on the one hand, of keeping borrowings down to a minimum, keeping cash and bank balances as low as possible, etc., and on the other hand, of securing the best possible return on capital employed in accounts, inventories, fixed properties, etc., by means of economical and efficient use of money invested in such assets.

Financing a business is a responsibility of the treasurer and financial management. Making economical

and efficient use of capital is a responsibility of executives and employees in all functions of the business, that is, merchandising, financial, and operating. Each plant, each branch and each department is in reality a separate business. Each uses its own capital, has its own organization, and does its own business. Therefore, the executive in charge of each of these functions and departments of a company must recognize and assume his responsibilities in the proper use of the total capital employed in such function and department.

Granting that it is desirable to give most department heads full and complete information covering detailed and departmental costs and financial figures, it is necessary, first of all, to educate them as to the bases on which these figures are determined, together with their meaning, the system used in accounting for the business, how to analyze the figures, and most important of all, how to get direct action which will correct errors and produce improved results. In the same way that a balance sheet, or operating statement, means very little to an inexperienced or untrained accountant, so also does the departmental statement, or any statement of costs mean but little, if anything, to an untrained department head or foreman. This emphasizes the need for organized training being given, particularly to foremen, so they will appreciate and make use of the information given to them.

In conclusion, it should be clearly understood:

1. That it is the responsibility of the accountant to deliver adequate and proper financial and cost information and analyses to executives, department heads, or those who are responsible for the various functional activities of a business.
2. That it is the responsibility of the executives and department heads receiving these figures, statistics, and analyses, to understand and make proper use of them.

In final analysis, this means that both the accountants and executives of financial, merchandising, and operating functions of a business should fully recognize and understand the problems and services of the other, and that there should be hearty co-operation on the part of all concerned, toward the securing of the best possible final results for the business as a whole.

Truck for Handling Gears

Index Number
658.281 Industrial trucks

MANY types of machine parts in process of manufacture need special forms of racks when moved from place to place on trucks, to keep the edges of the pieces from colliding and denting or chipping. The gears, shown in Fig. 1, for instance, would probably break across the teeth if they were thrown loose into a box when trucked to the next operation. In the interest of economy, however, they must be moved in quantities.

The truck shown in the photograph illustrates a good way of carrying a large number of pieces without breakage or injury. This truck holds 156 sets of gears and pinions without any touching of tooth surfaces, during transportation.

The base of the truck is a platform made of cast iron, having four wrought iron pipe legs screwed into it. The superstructure is formed by tapping holes in the top of the cast iron base and screwing steel bars into place to form uprights. The gears, pinions, collars, and other parts to be transported all have holes in the center so that when they are stacked over the uprights there is no contact between adjacent stacks.

This truck is easy to load. In addition, the next workman can remove the pieces, as he needs them, from the trucks standing behind his machine. Hence spoilage from careless transportation and careless handling is eliminated.

Types of casting other than those in the illustration will require different designs of retaining devices. Regularly spaced uprights may not do where there are no holes in the pieces to be carried. If the castings are rectangular, however, or so shaped that they can be held between posts, it is a simple matter to devise a layout of uprights suitable for the purpose. These uprights must be located with ample clearance for the castings in order not to interfere with quick loading and unloading of the truck. When designed correctly, trucks of this character save time and do away with extra handling, beside eliminating breakage.

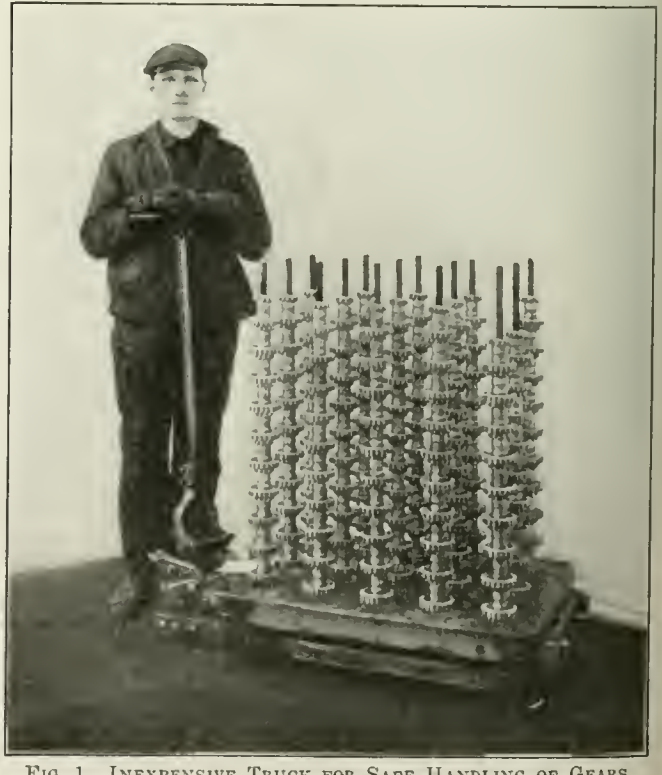

FIG. 1 INEXPENSIVE TRUCK FOR SAFE HANDLING OF GEARS

Organization of the Production Division

II—"A Co-ordinated System of Planning, Routing, Cost Accounting"

By FREDERICK A. WALDRON
Consulting Engineer

Index Number
658.5 Production management

A PREVIOUS article [1] has dealt with the engineering department in the organization of a factory for the installation and use of co-ordinated control and cost accounting methods. In a similar way this paper will treat of the duties and detail organization of the production division.

The production division is all that the name implies. Upon the completion of the design and equipment necessary to produce an article, it proceeds to manufacture in accordance with the specifications and instructions issued by the engineering division.

The chief of the production division should be one who is more of a business man than a mechanic. This does not imply that he should not have a mechanical training, but is intended to differentiate between the high-grade super-mechanic, who is generally a poor executive, and the man who is no mechanic at all. He should be a happy medium with an ability to control men, and recognize the mechanical necessities incident to producing a product. Above all, he must be systematic.

Having selected such a man, it is quite necessary that the functions of this department and its responsibilities be outlined by an organization chart, which should take the general form of Fig. 9.

The accuracy of the methods of handling the stores records is primarily a function of the accounting division. It is essential, however, in a well-regulated factory that the executive control of the physical portion of the stores should be under the control of the production division, as it involves close co-operation in ordering and handling of materials as well as the moving, and routing controlled by the division office.

Production Division Office

The production division office should be of sufficient size and should contain the necessary equipment which will enable a complete and economical control of divisional functions as shown in Fig. 9.

Within this office, the entire control of machining, moving, and time-keeping should be performed together with the activities controlled by forms for routing (Figs. 10, 11, and 12), Time Tickets (Fig. 13), Production Order (Fig. 14), Requisition on Stores (Fig. 15), Requisition for Worked Materials (Fig. 16), Standing Order (Fig. 17), Move Order (Fig. 18), Inspection Tickets (Figs. 19 and 20); and such other forms as are incident to the systematic control of factory operation and accounting. It is important that the equipment of this office as to trays, racks, desks, time clocks, adding machines, etc., should be complete.

Discipline

The discipline of the entire division is one that cannot be handled without considerable tact, and the

[1] MANAGEMENT AND ADMINISTRATION, January 1924, pp. 39-43.

WORKS MANAGER
↓
PRODUCTION DIVISION
Superintendent (or Chief)

Planning Routing	Machining	Assembling	Stores	Worked Material	Purchasing	Shop Transportation	Shipping Receiving	Personnel	Time Study
Production Office Standing Orders Route Cards Time Tickets Requisition on Stores Requisition on Worked Materials Move Orders Pay Roll	Condition of Machines Preparation Quality Speeds Feeds Currency of Tools	Methods Preparation Testing	Operating Control Maximum and Minimum Discipline Arrangement	Operating Control Maximum and Minimum Production Orders	Proper Supply of Materials in Quality and Quantity	Movement of Materials Passage-ways Special Labor-Saving Devices	Boxing Billing Listing Disposal of Goods Received	Employment Capacity Adaptability Welfare	Special Instructions Required

FIG. 9 FUNCTIONAL OUTLINE OF THE WORK OF A PRODUCTION DIVISION

Part No. _____ **ROUTE CARD**

Name _____

Date _____

OPER. No.	DESCRIPTION OF OPERATION	DEPT.	MACH. SYMBOL	T. & I. CARD

FIG. 10 MASTER ROUTE CARD FORM (5½ x 8½ IN.)

Part No. _____ **LOT ROUTE CARD** Lot No. _____

Part Name

PIECES ORDERED FROM STORE	CHARGE TO	DATE

OPER. No.	FULL LOT				PART LOT A				PART LOT B			
	No.	W DATE	M DATE	I DATE	No.	W DATE	M DATE	I DATE	No.	W DATE	M DATE	I DATE

FIG. 11 LOT ROUTE CARD FORM (5½ x 8½ IN.)

division chief should possess those qualities which will enable him to maintain a maximum attention to work without too much restraint.

Working Capacity

Too much effort cannot be given to the observing and rating of the working capacity of each employee and the adjusting of his work to the point of maximum efficiency. It is often the case that an employee is placed on work that he does not like or is not suited for, and oftentimes it is better to find a job he is fitted for than to discharge him and try to find another to take his place.

Personal observation and interest on the part of the division chief is probably the most efficient way in the long run to bring out the working capacity of the individual. The time and inspection tickets, however, furnish the exact records of the employees' performance.

One of the particular points in the working capacity of an employee is the ability to produce regularly and continuously, without unreasonable breakage of tools or spoilage of work. This feature can be greatly helped by proper machinery and tools, and careful instruction; or where instructions fail, shifting the employee to other classes of work.

Quality of work depends on the following:

1. The kind of material used.
2. Character of jigs or fixtures.
3. Sharpness and durability of cutting tools.
4. Quality and design of gages furnished.
5. Condition of machinery.
6. Skill of workmen.

All of these, with the exception of item 6, are provided for in the functions and duties of the engineering division.[2] It does not, however, follow that the last item is the least important, as all of them are of equal importance and any one may cause rejected or spoiled work. It would, therefore, devolve on the producing division to provide or train workmen of sufficient skill to produce the work required at the maximum speed and quality.

Tolerances

Where volume of output is required and a method of gage inspection is in vogue there is nothing more important than making the tolerances as liberal as possible. Owing to the wear and spring in all machinery and the dulling of cutting tools, the less latitude that is given on machining operations, the more expensive the work becomes, unless the labor of assembling is expedited by a close or restricted tolerance.

OPERATION NO.	**OPERATION CARD** DATE	PART NO.
NAME		DEPT.
DESCRIPTION		
TIME REQUIRED TO COMPLETE		HOURS
DATE	LOT NO.	NO. PIECES IN LOT / P. W. / D. W.

FIG. 12 OPERATION CARD FORM (3 x 5 IN.)

The work of employing labor at the present day has in many places reached a point where specialists are engaged for the purpose. It is not within the province of this article to elaborate on the work of specialists in any particular line, but to allocate the functions of factory control in the division that it logically belongs to. Where the activities of an industry are limited as to the number of employees, and it is desired to have a brief record of an applicant, the form Fig. 21 can be used for this purpose. This will give all necessary information for any reasonable reference.

EMPLOYE NO.			
SYMBOLS		NUMBERS	
GROUP		LOT	
SEC		PART	
DIV.		OP'N	
DEPT.		M'C'H	
TIME CARD	DAY WORK	NO. P'C'S	
		SP'L'D	
FINISHED		NOT FINISHED	
RETURNED			
ISSUED			
TIME			
RATE			
FOREMAN'S NAME		AMT.	
FOREMAN O. K.			

FIG. 13 TIME TICKET FORM (5 x 3 IN.)

[2] MANAGEMENT AND ADMINISTRATION, January 1924, p. 391.

Where welfare work is confined in extent and scope to one plant or locality, it can be quite properly placed under the direction and control of the production division. In the larger organizations having plants in various sections of the country, this branch is considered of sufficient importance to be placed in a division by itself with its chief directly responsible to the president, general manager, or board of directors.

Preparation of Work

The most important duty of the chief of this division is the preparation of work. He should always arrange work for the employee so that there shall be an elimination of all excuses for not performing work in sufficient quantity and requisite quality.

This can only be done by eternal vigilance and not taking anything for granted. He must be sure that his machines are in proper order and repair and in condition to receive the next job. This also applies to all tools, wrenches, gages, fixtures, or other implements necessary to enable the workmen to proceed immediately and to continue on the job until it is completed.

Speeds and Feeds

One of the most important functions of speedy and accurate work is the using of proper speeds and feeds for a specific job. The speeds and feeds should be systematically scheduled by the engineering division and the proper speeds and feeds for maximum results specified on the instruction or specification card. See Fig. 22.

It is the duty of the production division to see that the instructions as to these speeds and feeds are carried out. This does not, however, prevent suggestions as to changes in speeds and feeds that might increase the output.

Such changes should not be made without the authority of the engineering division, as oftentimes what apparently seems to be an improvement resulting in temporary increase in production proves later on to have been a fallacy on account of the large number of spoiled pieces or the time lost in grinding or changing tools, or sacrifice in quality of work.

While the general condition of machine tools will automatically be taken care of through the inspection and maintenance divisions, it is of prime importance that the producing division reinforce this inspection by careful observation of the condition of machines in order that no delays may take place in production. If a machine breaks down or becomes inoperative its condition should be taken up with the inspection or maintenance division at once. This condition should be anticipated and troubles remedied before a machine is to be used.

Too much cannot be said as to the direct results obtainable by making the atmosphere and physical surroundings pleasant and healthful for the employee.

On all apparatus, safety devices which will guard against injury to the operator should be installed wherever production is needed. Order and neatness combined with cleanliness should be a part of the day's work and regarded as important as any other function of this division.

Piece-Rates and Time Study

The term piece-rate, as used here, applies to any method of compensating labor other than the straight hour or day rate. All rates should be set by a careful study of not only the

REQ. ON STORES

SYMBOLS	NUMBERS
GROUP	LOT
SEC	PART
DIV	NO PCS
DEPT	WT.
DATE	VALUE
ISSUED	BY
RECEIVED	
ENT. ANAL. BK	

TO STORE KEEPER
PLEASE ISSUE ABOVE MATERIALS TO FACTORY

ENT. ON ANAL. SH | FOREMAN

FIG. 15 STORES REQUISITION FORM (5 x 3 IN.)

REQ. FOR WK. MTLS.

SYMBOLS	NUMBERS
GROUP	LOT
SEC.	PART
DIV	NO. PCS
DEPT.	WT
DATE	VALUE
ISSUED	BY
RECEIVED	
ENT. ANAL. BK	

TO STORE KEEPER:
PLEASE ISSUE ABOVE MTLS FOR COMPLETION OF ORDERS.

ENT. ON ANAL. SH | FOREMAN

FIG. 16 WORK MATERIALS REQUISITION FORM (5 x 3 IN.)

LOT NO. | STANDING ORDER | PART NO.
DATE

NO. PIECES	OPERATION NO.	MACH. NO.	HOURS PER PIECE

DESCRIPTION OF OPERATION

INSTRUCTION CARD NO.	OPERATION HELD UP FOR REPAIRS TO	HELD UP BY: FIXTURES / MOTOR
DRAWING NO.	STARTED AGAIN	GAUGES / MACHINE; TOOLS / BELTS; COUNTERSHAFT / MISC.

FIG. 17 STANDING ORDER FORM (3 x 5 IN.)

LOT NO. | PRODUCTION ORDER | PART NO.
DATE

NO. PIECES | REPLACE ORDER

PLEASE MACHINE THE FOLLOWING

WANTED COMPLETE | SIGNED | STOREKEEPER

NO. PIECES RETURNED | DATE

REPLACE ORDER ENTERED

THIS CARD TO BE DETACHED FROM STUB AND HELD IN STORE

THIS STUB TO BE KEPT WITH WORK AND RETURNED TO STORE WITH IT.

NO. PIECES | LOT NO. | DATE SENT OUT | PART NO.

FIG. 14 PRODUCTION ORDER TAG FORM (7 x 3¼ IN.)

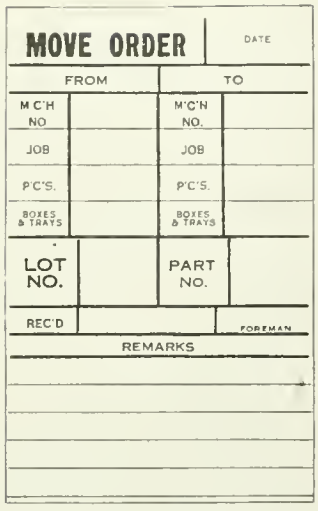

FIG. 18 MOVE ORDER FORM (5 x 3 IN.)

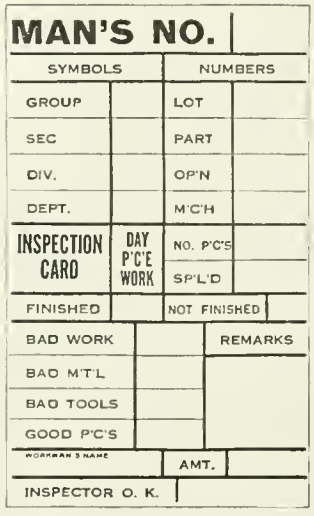

FIG. 19 INSPECTION CARD FORM (5 x 3 IN.)

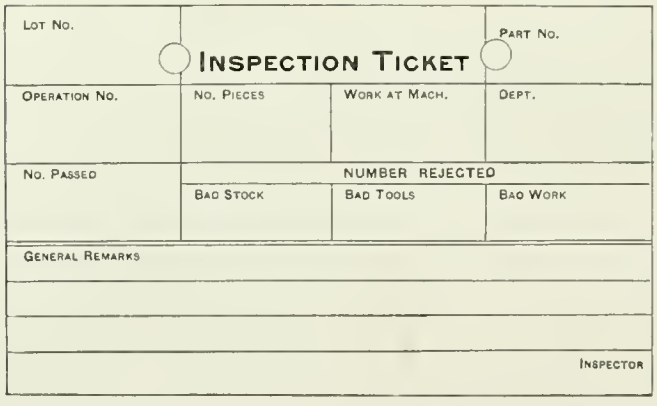

FIG. 20 INSPECTION TICKET FORM (3 x 5 IN.)

time required to do the work, but conditions surrounding the job; and should be made in a manner that will admit of flexibility, bearing in mind the following principles:

1. When a factory has its product oversold, and is behind in orders, make one machine produce all that it can regardless, to a certain extent, of the number of men required to operate it.
2. If a factory is undersold, and it is desired to hold a nucleus of an organization together, it is desirable to obtain the maximum production per man regardless of the number of machines he is required to run.

To illustrate this, let us assume an oversold product, where the constricted point is located on one or two machines. If by putting a helper on this machine to assist the operator, an increased production of from 10 to 15 per cent is obtained, it is advisable to do this even at an advance in the rates paid per piece. If, on the other hand, the product is undersold and business is slack, it is desirable to have one man operate as many machines as he can, economically.

The basic results of these two plans are as follows:

1. With the oversold condition of the plant the small amount of money paid in addition to the regular rates for the increased output is more than made up for many times over, in the increased volume of shipments and the correspondingly greater collections.
2. In the case of the undersold factory the overhead for plant and machinery is fixed and the object under these conditions is to keep the cash expenses to the lowest possible point by having one man run two or more machines. The cash spent per unit for labor is reduced to a minimum without seriously detracting from the weekly amount received by the workmen.

Just a word is advisable in regard to methods of time study. The most convenient and practical outfit for making time studies is the one devised by Messrs.

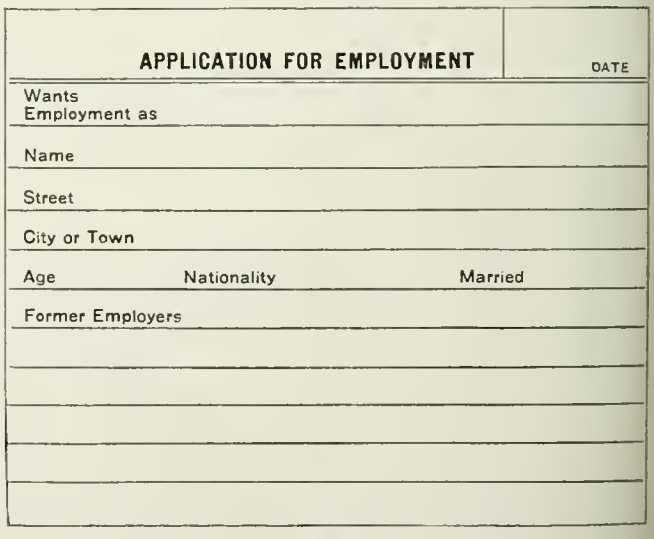

FIG. 21 APPLICATION FOR EMPLOYMENT FORM (4 x 5 IN.)

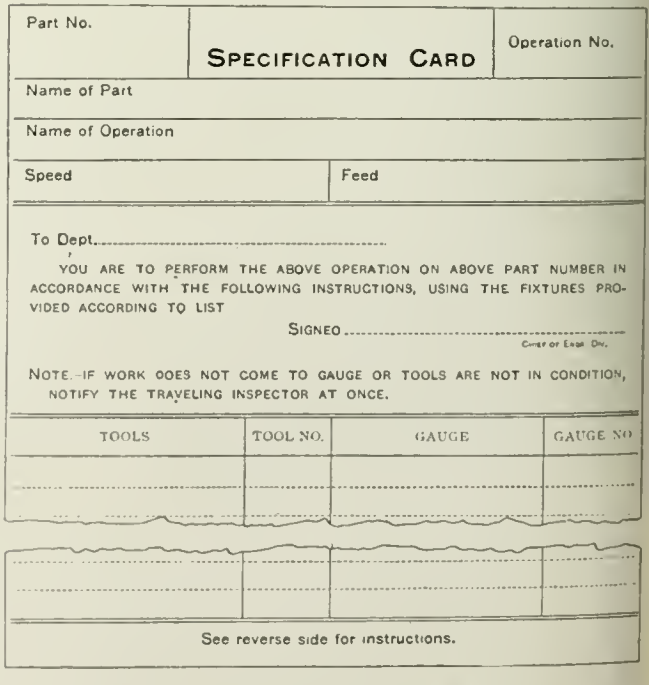
Part No.
SPECIFICATION CARD
Operation No.
Name of Part
Name of Operation
Speed
Feed
To Dept.
YOU ARE TO PERFORM THE ABOVE OPERATION ON ABOVE PART NUMBER IN ACCORDANCE WITH THE FOLLOWING INSTRUCTIONS, USING THE FIXTURES PROVIDED ACCORDING TO LIST
SIGNED
NOTE.—IF WORK DOES NOT COME TO GAUGE OR TOOLS ARE NOT IN CONDITION, NOTIFY THE TRAVELING INSPECTOR AT ONCE.
TOOLS
TOOL NO.
GAUGE
GAUGE NO.
See reverse side for instructions.

FIG. 22 INSTRUCTION OR SPECIFICATION CARD FORM (8½ x 5½ IN.)

Taylor & Barth, and it would be very difficult to improve upon it.

The main feature in any time study is to have your organization built up to such a point that the results obtained can be consistently and permanently used. In any event, after a rate is once established, faith should not be broken with the workmen and never should the rates be changed except in case of improved methods requiring new machinery or fixtures, or by mutual consent at periodical wage adjustments.

The control of shipment should be in the production division and a capable and efficient man should be placed in full charge of all shipments. Crating and packing should be thoroughly done and invoices and shipments listed. Any instructions required in setting up or starting the apparatus or machinery should be incorporated with the shipment, or mailed in ample time to reach the destination with or before the materials shipped.

A systematic and thorough method of receiving goods is absolutely essential in any well-organized plant. The extent of the receiving depends largely on the amount of material received. Sometimes, the receiving and shipping may be under the immediate supervision of the same man. Another way is to have the storeskeeper directly responsible for the receipt of all goods; and where the volume of business is sufficiently large, to keep a well-paid man in charge of receiving.

With the present price and scarcity of labor, goods should be received and handled with the idea of reducing the cost of internal production, and it might be economical to have a number of receiving points.

(To be continued in the March issue.)

Industrial Gas Laboratory in San Francisco

By CHARLES W. GEIGER

Index Number
662.76 Gas as fuel

IN recent years the use of gas for heating and industrial purposes has become general. Gas rivet-heating was adopted by most of the big shipyards during the war, and has now become firmly established as the most efficient and economic method.

While gas has had an opportunity to demonstrate its value in the large shipyards and corporations, some thousands of small factories and shops have yet to be convinced that gas is better and cheaper in the long run than any other fuel which they might employ; hence the necessity for the gas industry to demonstrate the uses to which gas may be put and the excellent results to be attained. To this end the Pacific Gas and Electric Company has opened a modern gas laboratory and demonstration plant in San Francisco. The building is of the factory type and contains a floor area of 8,400 sq. ft. It has been equipped with almost every type of modern gas appliance which might be used in industry, and it is the idea of the company to have its industrial engineers demonstrate this equipment to its consumers in order to prove the value of gas as a fuel.

In making recommendations it is essential that the proposed method of utilizing gas be thoroughly demonstrated. The laboratory as it is constituted answers every requirement in this particular. The industries of the Pacific Coast have not an opportunity to bring their problems to the gas company with the certainty that they will receive accurate and scientific information. It is quite feasible for a manufacturer to bring in samples of steel to be treated, have the work done under his personal observation in a gas fired furnace, and obtain a complete report as to the quality of work produced and the cost of doing it.

Many types of equipment are installed in the laboratory. One section is devoted to hotel installations. Near this is the candy-maker's equipment ready for operation. With atmospheric and blast burners, work can be done quickly and surely. Recently, the sales of this type of furnace have greatly increased. The next appliance is the bake-oven burner, mounted on a post for demonstration and equipped with fan and motor which furnish the air at three ounces pressure to the burner. The burner is mounted at the side of the open door and the brass swivels permit it to swing at any angle. Thus the flame can be directed on the sides of the oven.

FIG. 1 DEMONSTRATING HEAT TREATMENT IN A GAS FURNACE

FIG. 2 GENERAL VIEW OF THE PACIFIC GAS AND ELECTRIC COMPANY'S INDUSTRIAL GAS LABORATORY

The next installation is the "dry room," in size about 8 x 12 ft., and lined with sheet metal. This room is heated by hot pipes through which gas is fired from an ordinary Johnson burner. The pipes are vented and dripped and no moisture enters the room. Air is admitted around the pipes and exhausted by a fan.

The next section is devoted to heating, which includes factory and office buildings. A separate display is maintained elsewhere by the company for residential heating. The first appliance is the Hall furnace, a battery of these burning 1,000 ft. of gas per hr., air being supplied by a No. 5 ventilating fan driven by 3 hp. motor. These furnaces supply 5,000 cu. ft. of hot air per min., or nearly a third of a million cubic feet an hour. Furnaces of this type are particularly adapted for heating large open spaces where steam or radiator equipment would be prohibitive in first cost. Metal work can be installed to suit the individual requirements for delivery of air, but on account of the diversity in piping methods the demonstration furnaces are not fitted with a complete distributing system.

The laboratory has a No. 18 Bryant steam-boiler installed complete with radiators in offices above the boiler-room, and the entire system is covered with asbestos insulation. It is kept in working order subject to observation and test by prospective users. The Minneapolis heat control is applied to this system and regulates the fuel to the boiler in accordance with heating requirements. A No. 66 Bryant is also set up for display.

The next heating display is the Rector system, suitable for installations where unit heating is required and economy is a factor. Some large factories have been equipped with this system, the American Can Company being a notable example.

The next display is of high-pressure boilers. This exhibit consists of a battery of Kane boilers, one 10 hp., one 8 hp., and one 5 hp., inter-connected so that any one may be used. A small 4 hp. McKee boiler completes the battery. All steam lines and return lines are inter-valved so that any desired operation can be effected. These boilers supply steam to the dry room and to a 500 gal. wooden tank with a partition in the center. One side of the tank has a coil and the other side an open jet. A 26 in. steam-jacketed kettle is also connected. Condensation from these appliances is returned by a steam trap to a receiver tank, from which it is automatically pumped back to the boilers by a small reciprocating steam pump made by the Simons Machinery Company. All appliances are operated through a 150-A master meter, and each section, in addition, is again metered through Sprague iron meters. Portable recording meters are also provided for testing purposes.

This brings us to the laboratory instruments, which really need no description except to say, in general, that a standard calorimeter, optical pyrometer, various types of thermocouples, Orsat set, thermometers, etc., are provided.

The metal treating section is the most complete of any department, it being the theory that in a growing industrial section this branch of business should be specially encouraged. It has been the case, at least on the Pacific Coast, that the heat treatment of metals with gas has not received the attention it deserves, and as a consequence that branch shows the least growth. This was determined accurately by an industrial survey of all territory served and an analysis of all industrial consumers which showed that the metal treating end of the industrial load was not so important as it should be, hence the effort to concentrate on that branch. Only about 20 per cent of the gas output went into factories.

The metal treatment department has a complete line of furnaces and equipment for all kinds of work which can be done with gas. There are 30 different furnaces for this work connected and ready for operation. The largest of these is a Tate-Jones series A, 12 x 18, weighing a little over two tons.

A careful record is kept at the laboratory of all demonstrations and tests for customers. These are later checked with sales, and it has already been proved that enough business has been secured to justify the investment.

Executive Control of Future Results

A Graphical Method of Company Plan and Performance

By WALLACE CLARK
Consulting Management Engineer

Index Number
658.1 Executive control

WHEN an executive of a manufacturing corporation returns to his work after an extended absence and takes up the reins again, he finds that in reading reports and interviewing subordinates he is consciously or unconsciously seeking information as to the movement of the work under his charge rather than its exact status at the moment. He may ask how a certain matter stands at present, but when he secures the facts he compares the situation with the way matters stood at some previous time and then he draws conclusions as to future developments.

The executive to whom the guidance of a corporation is entrusted is expected to foresee future happenings and to take action either to change the course of events or to take advantage of those events in the interest of his company. He is therefore concerned primarily with the future and the time he devotes to investigating and considering what has already taken place is worth while only in so far as it throws light on what is likely to happen. He can influence the future but not the past.

In his attempt to foresee conditions and events the modern executive is learning to consider the various parts of his business not as static but as moving forces. There is, for instance, a more or less steady movement of material through a manufacturing plant and of finished goods through a distributing organization, with a returning stream of orders and money from the selling to the producing departments. A study of these forces convinces the executive that the effectiveness of his personnel and methods may be judged by the rate of flow of work through his organization. Realizing, then, that the work under his charge is composed of moving forces, the task of the chief executive is to control and direct the flow of those forces.

The first step in that direction is to measure the rate of movement of work. The factors which influence the

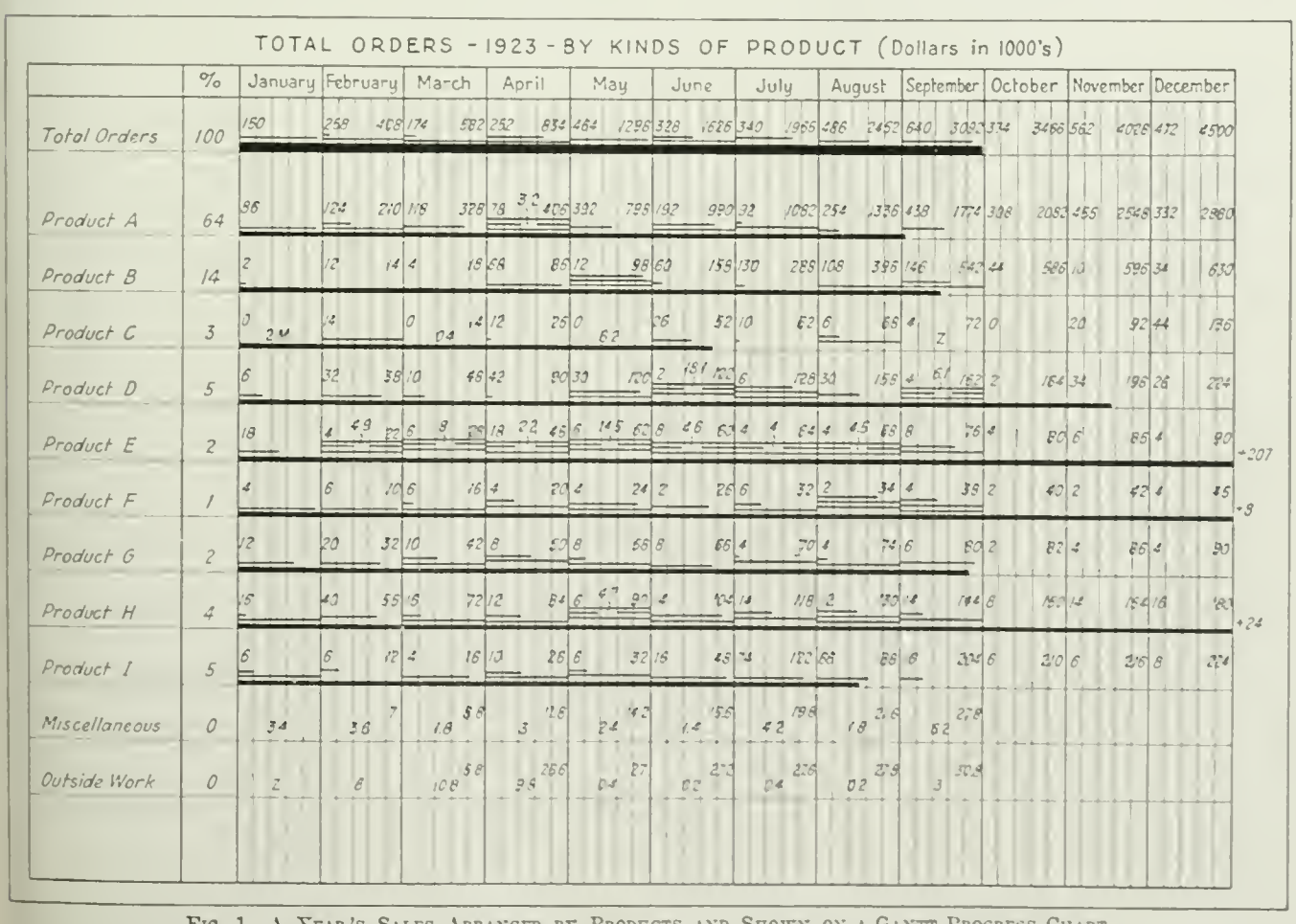

FIG. 1 A YEAR'S SALES ARRANGED BY PRODUCTS AND SHOWN ON A GANTT PROGRESS CHART
The figures represent the plan made at the beginning of the year. The lines show actual sales.

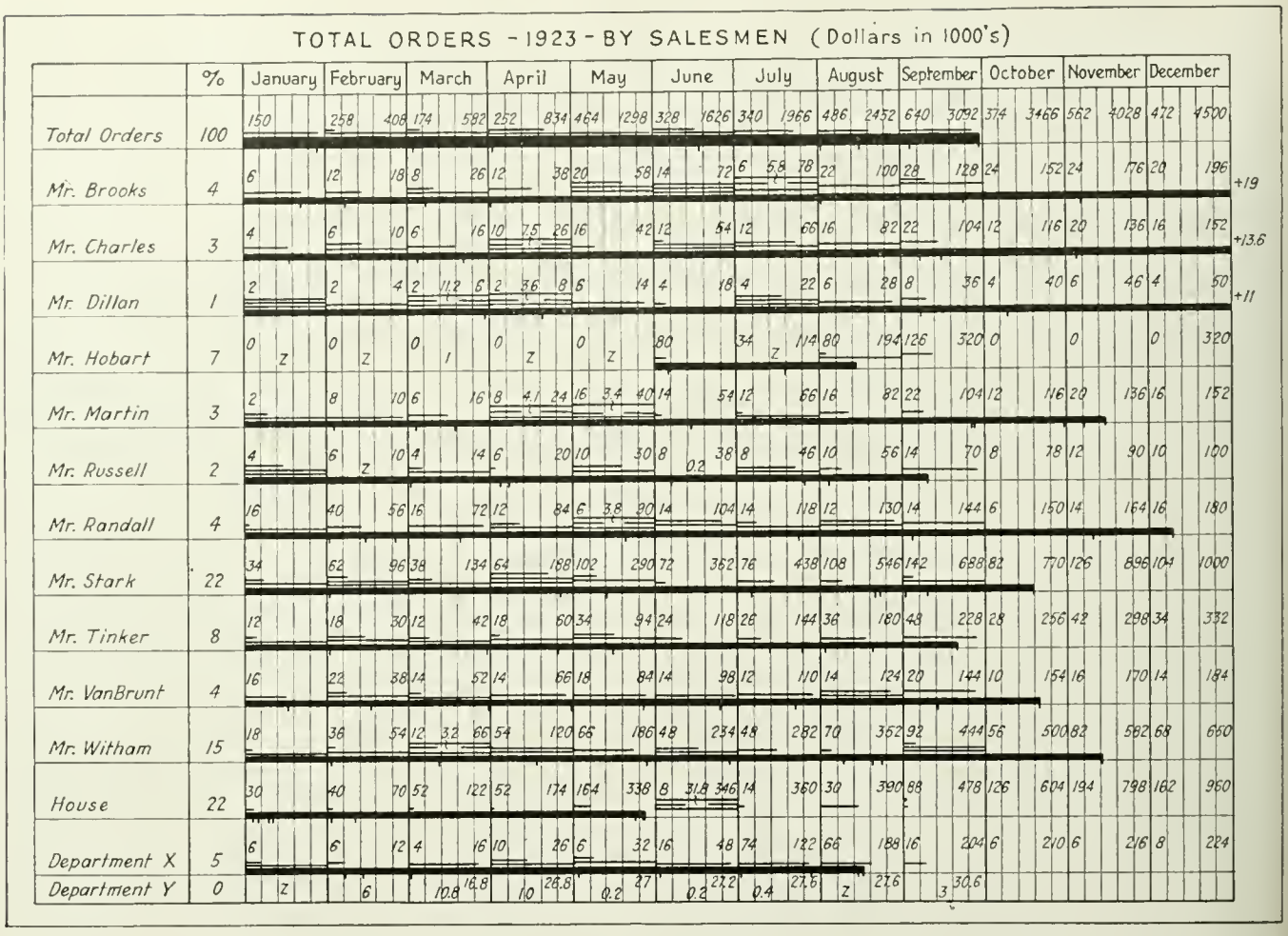

FIG. 2 A YEAR'S SALES, SHOWING THE QUANTITIES SOLD BY INDIVIDUAL SALESMEN

progress of any single phase of a modern business are so varied that it is difficult to find a yardstick with which to measure its rate of movement. Seasonal fluctuations, the trend of business in general, the policies of competitors, and changing conditions in other parts of the same business all have their effect. If an executive must analyze the whole situation and take all of these things into consideration whenever he receives a new figure or report, the task becomes burdensome and is sure to be neglected, but even the old-fashioned executive has learned during the last few years that he cannot afford to lose sight of the business cycle or of tendencies outside his own business. He appreciates the fact that the very existence of his company may depend on his ability to foresee conditions and to prepare for them.

The modern executive, therefore, wants to simplify his study of tendencies and to measure the flow of work in a way which will be stimulating rather than wearisome. The most effective method, and the one which consumes the least time, is for him, at the beginning of a year, a season, or any other period, to analyze the business situation as a whole as well as conditions in his own company and to lay out a plan which, if adhered to, will produce the results at which he aims. When reports are received at stated intervals during that period, he compares the figures or events with his plan. All the variables which could be foreseen have been taken care of in the plan, so, when actual progress differs from what was planned, it is evident that something has happened which was not expected and therefore requires attention.

The executive is thus relieved of the necessity for spending time on those phases of his business which are making satisfactory progress and is left free to concentrate his attention on those things which are not moving at the desired rate. He looks for the cause of the delay or the accelerated movement and, when he learns it, he considers in the light of his past experience the probable effect on his business. He then takes action either to retard or speed up the movement of the phase of his business which is not satisfactory or, if it is beyond his control, he adjusts the rate of flow of the other phases.

A specific example may make this method clear.

The chief executive of a certain manufacturing corporation at the beginning of 1923, after considering the sales of his company for the last several years, the probable conditions of general business during the coming year, his advertising program and other things, aimed at total sales amounting to $4,500,000. This was not intended merely as a figure to shoot at, but one which he could reasonably expect to attain if his manufacturing and selling organizations did their work with sufficient skill and energy.

The total sales or orders were then divided up by products and the quota for the first item, "Product A," which he believed should be 64 per cent of the total, was set at $2,880,000. Quotas for the other kinds of product were arrived at in a similar manner (Fig. 1).

Most of these products had pronounced seasonal variations, which were, accordingly, studied from records of past years and monthly quotas were worked out for each product. These amounts were then footed up and monthly figures arrived at for total orders. All of these figures were then entered on a Gantt progress chart (Fig. 1).

Since orders must be brought in by the sales force it was obviously necessary to indicate clearly to each salesman what was expected of him. Monthly quotas were accordingly worked out for salesmen after taking into consideration the kinds of product in which they specialized, their territories, their sales in past years, and various other matters. These figures were also entered on a Gantt progress chart (Fig. 2), the total orders to be brought in by salesmen being, of course, to avoid overtaxing his machine capacity. With this production program as a basis, he then developed a schedule for expenditures: first, the pay-roll for direct labor, that is, those workers whose wages could be charged directly to specific orders; second, purchase of material; and third, indirect expense, i.e., money paid for the administration of the business as a whole, supervision, maintenance, and other purposes not traceable to the acceptance of any specific order.

Fig. 3 shows how indirect expense was followed. Each of the five divisions of this expense were in turn subdivided into numerous accounts and charted in a similar manner, so that when one of the major accounts appeared to be excessive, the executive could send for the detail charts and see what item was out of line. The total line on this chart, being very close to the quota at the end of nine months, indicates that in this instance future expenses had been foreseen with considerable accuracy, and that the machine rates, which had been based on the predetermined expense, were substantially correct.

INDIRECT EXPENSE = ACTUAL COMPARED WITH PREDETERMINED 1923

	A/C	January	February	March	April	May	June	July	August	September	October	November	December
Total Expense	=	$31,338	263 M	394 M	525 M	657 M	788 M	919 M	1,051 M	1,182 M	1,313 M	1,445 M	$1,576 M
Administration	"A"	23,912	48 M	72 M	96 M	120 M	143 M	167 M	191 M	215 M	239 M	263 M	287 M
Buying & Storekeeping	"B"	5,754	12 M	17 M	23 M	29 M	36 M	40 M	46 M	52 M	58 M	63 M	69 M
Production	"P"	68,478	137 M	205 M	274 M	342 M	411 M	479 M	548 M	616 M	685 M	753 M	822 M
Selling	"V"	28,436	57 M	85 M	114 M	142 M	171 M	199 M	227 M	256 M	284 M	313 M	341 M
Shipping	"W"	4,738	10 M	14 M	19 M	24 M	29 M	33 M	38 M	43 M	48 M	52 M	57 M

FIG. 3 CHART SHOWING THE INDIRECT EXPENSE OF A MANUFACTURING CORPORATION

the same as the quota divided by products on the preceding chart.

Throughout the year as the monthly reports of orders were received, lines were drawn on the charts to show how the actual orders compared with the quotas. It will be seen from the lines on the two charts (Figs. 1 and 2) that at the end of nine months the total sales were remarkably close to the estimate made at the beginning of the year, although some of the individual salesmen and products were far above or below their quotas.

When at the beginning of the year this executive planned his sales, he also worked out his production program, leveling the inevitable sales peaks in order to keep his workmen employed throughout the year and

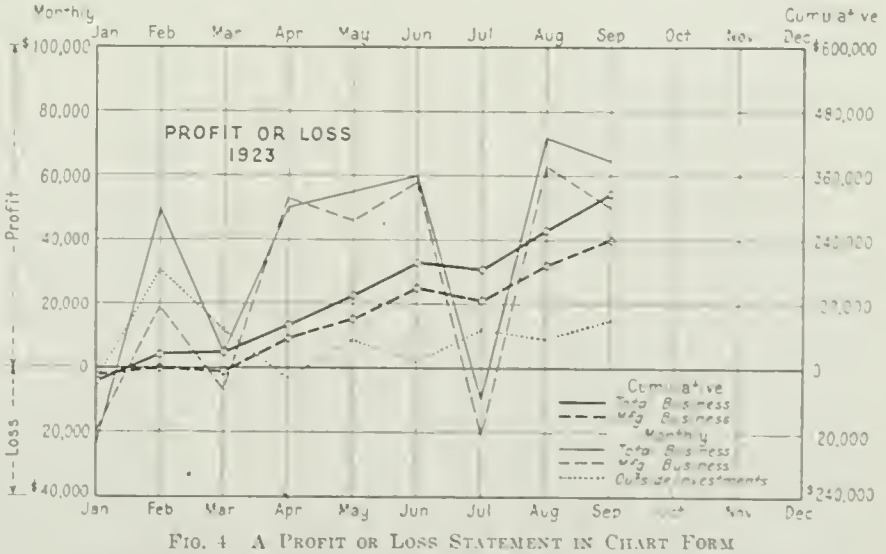

FIG. 4 A PROFIT OR LOSS STATEMENT IN CHART FORM

Light lines read from the scale on the left show monthly profits, heavy lines and the scale on the right indicate cumulative profits.

These charts, showing the amounts paid out for wages, materials, and overhead, were supplemented at the end of each month by a report of amounts charged to manufacturing orders, to inventories, and to idleness accounts. This showed what had become of the money spent and directed particular attention to the cost of idleness and the reasons for it.

Other charts were drawn for investments in land, buildings, equipment, inventories of raw material, of work in process and of finished goods, as well as investments in subsidiary corporations and in securities. There were also charts of a purely financial nature, such as amounts invoiced, collections, accounts receivable and payable, cash in bank or on hand, et cetera.

The final chart of this series showed the "Profit or loss" (Fig. 4) month by month as well as the cumulative total to date, and indicated the net result of all the activities followed in detail by the other charts.

It will be seen that the method of control indicated in the foregoing example serves among other things to clarify the aims and the policies of an organization. When a program is drawn up for a year, or even a shorter though definite period, it follows inevitably that investigations will be more thorough, plans more carefully made, and responsibilities for the execution of plans more clearly fixed than when a program is not worked out long before the time when it is to be used.

The purpose of a manufacturing organization is to produce all that can be sold at a fair profit without overtaxing its workmen, with a minimum investment in floor space, equipment, and supplies and with the least possible waste of workmen's time or of material. When a program is drawn up on this basis and actual production and expenses compared with it, the task of the executive is simplified and he is enabled to secure a better control over the moving forces of his business.

The outstanding features of the methods of control which have been described are: first, a conception of business as composed of moving forces; second, a running comparison of actual performance with what has been planned; and third, an understanding and control of these changing streams of work.

The outstanding problems which an executive faces today seem to be more complex and their solution more imperative than ever before. He cannot gamble with advertising appropriations, his sales organization can no longer be mere "order takers," his costs of manufacture must be low, his workmen well trained, and his inventories watched with great care. His organization is moving rapidly and he must maintain an accurate balance in all its parts so that he can effectively direct and control its future.

A Combined Hoist and Truck

Index Number
658.281 Industrial trucks

HOISTING and transportation service is required at many points in the average industrial plant where a fixed installation such as a crane, a hoist, or some type of conveyor is not provided. Service of this kind is often needed in places that a locomotive crane cannot reach, or in work for which a machine of this size is uneconomical.

The small hoist truck illustrated in Fig. 1 is directly suited for quick and efficient use in such work. It consists of a body mounted on rubber-tired wheels, and carrying a stout column which supports a derrick. The derrick arm can be swung in any direction about the post. It is of sufficient length and elevation to handle a box or other load 6 ft. high between derrick hook and floor of truck.

This arm is swung out over the object to be lifted and the hook, carried on a chain running over two sheaves, is lowered by means of an electric motor operated from the crane pedestal. The load is then attached and raised high enough to clear the truck platform, after which it is swung in and deposited on the truck. The derrick arm is revolved by hand.

When the arm is lifting the load, the truck is prevented from upsetting by the weight of the platform, pedestal, and storage battery, which keep the center of gravity of the load within the wheel base. All of the truck parts must be of sturdy construction to withstand severe strains and hard wear. The bearings of the derrick must be kept well oiled to make it easy to swing.

As shown in the picture, the reach of the derrick arm is regulated to the position of the load by a series of locking lugs on the under side of the arm supporting the derrick. When the hook is raised to support the boom this arm can be released from its retaining pin and locked in place after the boom is lowered to reach the load.

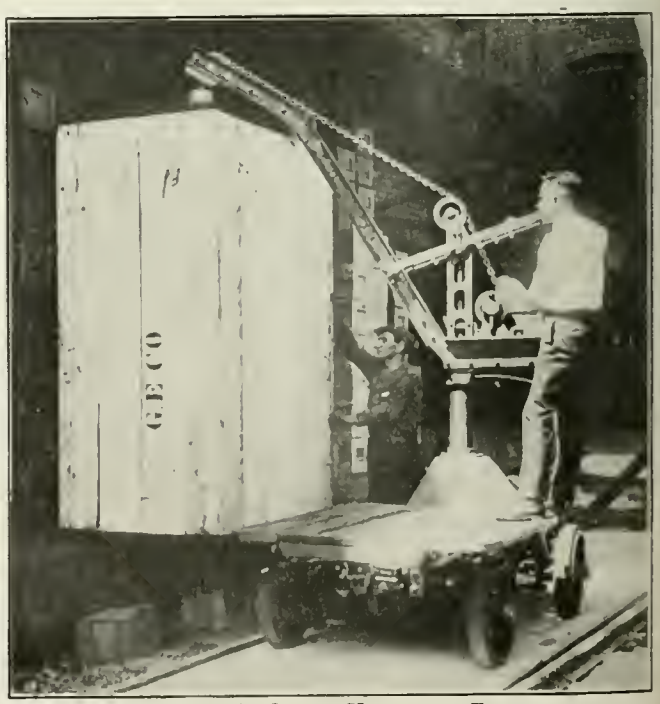

FIG. 1 SMALL HOIST AND TRUCK

Operating Adjustments Under Standard Costs

"Increased Profits Through Control of Costs"—Article Six

By R. W. DARNELL

Controller, Ritter Dental Manufacturing Co.

Index Number
657.524 Cost control

A GREAT many companies have been content with using their cost system as a means of securing individual costs, to be used possibly in fixing selling prices, but have not tied it up with their general accounting system.

This has perhaps been due to the fact that they were unable to secure perpetual inventories which are in reality the connecting link between the cost system of the factory and the general accounting system which covers more or less completely the operations of the whole establishment.

In this, the last article of his series, Mr. Darnell discusses the perpetual inventory as an essential element of effective cost control, explaining its function, its place in the system of standard costs, and its monthly adjustment to meet the inevitable discrepancies between standard and actual costs. Adjustments for material, labor, and overhead are taken up in turn. The article concludes with a brief consideration of the labor control possible under an effective cost system.

The perpetual inventory is so widely known that it needs no detailed discussion. It simply means what the term implies, that is, a system of inventory records that will make available at any time the exact inventory value, and inasmuch as this record gives the inventory value from month to month, the cost system may be tied into the general records in such a way as to permit operating and financial statements to be taken off at the end of each month.

There surely can be no argument as to the desirability of taking off these statements monthly as, when this is done, the exact status of the business is known shortly after the completion of each month's business, instead of working until the end of the year for the taking of a physical inventory in order to determine what the results of the manufacturing activities have been. It does not take much argument to convince the average manager that he should have operating statements each month, but what he wants to know is how to collect the information necessary to give him these records. Probably the most practical and simplest method is by the use of the factory ledger.

Opening the Factory Ledger

The factory ledger is nothing more than a subsidiary ledger to the general ledger and contains only the inventory accounts. Many other clearing accounts may be necessary to arrive at the correct inventory figures month by month, and these are also carried in the factory ledger, but the fact remains that after all the work on the factory ledger has been completed for the month, the only accounts which show a balance are the inventory accounts.

It is probably best to start the factory ledger at the beginning of the fiscal period after a physical inventory has been taken and proper perpetual inventory records have been set up in the cost department. The inventory taken at the end of the preceding fiscal year is necessary for the general accounting department to close up its books and take off the necessary operating and financial statements. When opening up the factory ledger, it is necessary to transfer the inventory accounts from the general ledger to the factory ledger. This is done by creating a new account in the general ledger, known as "Factory Ledger," and charging the inventory against this account. In the factory ledger the first account opened is known as "General Ledger," and to this is posted, as a credit, the inventory which has been transferred from the general ledger. As many accounts as may be thought desirable can be kept on the inventory itself, and whatever division of the inventory is made should be indicated by specifically named accounts in the factory ledger. To these accounts, and offsetting the credit to the General Ledger account, will be charged the amount of inventory in those particular divisions. This is all that is necessary in order to open a factory ledger.

Operating the Factory Ledger

During the month as bills are paid, classified, and charged through the voucher register, amounts are being paid for materials, pay-rolls, and sundry other expenses on items such as insurance, taxes, etc. These accounts under the annual inventory plan are carried in the general ledger and allowed to accumulate from month to month until the end of the year, when they are summarized under the Merchandising account and closed out. Very much the same method is pursued when the factory ledger is operated, excepting that at the end of each month after the voucher distribution has been posted to the various accounts in the general

ledger, the accounts which affect the inventory are closed into Factory Ledger account. A journal entry of all these transactions is made and a copy given to the person responsible for the factory ledger.

The factory ledger has accounts corresponding to the distribution in the general ledger and these accounts are charged with the amounts indicated on the journal entry. At the same time, the General Ledger account is given credit for that which has been charged to the factory ledger. Through a series of journal entries, the various accounts are closed out and charged into the various inventory accounts.

In order to maintain the perpetual inventory, it is necessary to ascertain the factory cost of the goods which have been sold during the month. This can easily be determined by the use of an extra copy of the billing going to the cost department, from which each item of merchandise sold is costed out at its factory cost. The total cost of sales is then credited on the factory ledger to the inventory accounts affected, reducing the inventory balance, and charged against the General Ledger account, similarly reducing the balance which is charged against the factory. This leaves only the inventory which exists at the end of the month. A copy of the journal entry affecting the General Ledger account in the factory ledger is given to the general ledger bookkeeper who credits the Factory Ledger account in the general ledger and charges cost of goods sold. All the figures necessary for securing an operating statement are now at hand in the general ledger, and it is simply a matter of summarizing the accounts to arrive at both the operating and financial statements.

Material Variations

Reference has been made from time to time to the fact that there may be, and usually is, a variation in actual cost from the established standard costs. Inasmuch as all the monthly costs which have been used in the cost of sales figures are standard costs, it is plain that the profit figures which result are incorrect by the amount of the variation from standard costs which has occurred within the month in question. Therefore, in order to secure the actual profits some means must be found to work these variations from standard through the inventory accounts and finally into the cost of sales figures.

First, in these variations might be considered material variations which were explained somewhat briefly in another article.[1] It has been pointed out that standard material costs are made up of material costs which have been figured at an arbitrary standard and are kept there throughout the period.

It is impossible to expect that there will be no variation from the material standards which have been set up as there is more or less variation in the prices paid for materials each time they are purchased. In some cases, as in a plant using ordinary materials such as gray iron castings, brass castings, steel forgings, sheet and bar steel, brass, copper, etc., the variations from month to month, or over a period of a year, for that matter, are not usually very great, varying over a period of several months not more than 2 per cent or 3 per cent. If material costs can be secured which are 97 or 98 per cent correct, there is not much fault to be found with the method of costing.

When invoices for materials are paid, they are charged against the various rough stores accounts at the invoice price. After making a distribution of each invoice and charging the various inventory accounts with the amounts paid, it will, as intimated, be found that the charges made against the rough stores inventory have really been made at actual cost, whereas the cost of the same material has been figured in the factory cash at an arbitrary standard which may or may not be the actual cost. As the inventory accounts are cleared by means of cost of sales, it follows that the inventory has been charged at actual cost and is being reduced on a standard cost basis. An adjustment is therefore necessary to take up any variations between standard cost and actual cost and keep the inventory account in proper balance. For instance, if the purchase of raw material during the month has amounted to $100,000 actual cost, and the standard cost of this same material is $97,500, it is necessary to adjust the inventory by $2500 in order to keep it on a standard cost basis.

The amount of the adjustment on each item is determined at the time it passes through the perpetual inventory records maintained in the cost department, and these differences are kept in the form of a plus and minus variation, that is: if material is purchased at a less cost than standard, it is shown as a plus variation; if purchased at a figure higher than the standard, it is entered on the variation sheet as a minus. At the end of the month, the plus and minus items are totaled and the net result obtained. If, for instance, it is found that the variation from standard has amounted to a plus $2500, it means that the inventory must be increased by $2500 to bring it up to a point equivalent to the standard which has been used in the cost.

This plus variation also indicates that the standard which has been set up is higher than actual cost, and inasmuch as the standard cost has been used in the cost of sales figures, and the inventories reduced accordingly, it is necessary to carry the material variations on to the factory ledger as a debit to rough stores inventory and a credit to the general ledger. These variations when received by the general ledger bookkeeper will be debited to Factory Ledger account and credited to cost of sales. By this transaction, the Inventory account is placed on the basis of standard cost, and the cost of sales which has been figured too high is reduced to the actual cost basis by the reduction indicated by the variation.

Labor Variations

Another variation which must be taken into consideration is the labor variation. As has been said, the only variation from the labor standard is when an operator fails to make premium, and the attention of those in the cost department is devoted to securing labor variation costs rather than actually to compiling

[1] MANAGEMENT AND ADMINISTRATION for January, 1924.

costs. This is accomplished by taking the premium time tickets turned in by the operators and sorting out the losses.

If a man has lost one hour on a job, he has been paid for one hour's time more than was calculated in the standard costs. Therefore, if he had an hourly rate of 60 cents per hr., he has lost for the company 60 cents over what it had determined upon as standard and which was used in the costing. These variations are accumulated from day to day and at the end of the month are totaled and the labor variation thus determined.

It was shown that in compiling the standard cost, a standard departmental wage average was used on the different operations to determine the standard labor costs. In practice this will likely vary from month to month due to the fact that new employees are being engaged, old ones leaving, and advances in pay being granted, all of which will slightly affect the standard departmental wage average. This variation is determined by taking the total number of productive hours operated in a given department in a given month, and multiplying this first by the average rate used in the standard cost and then by the actual average productive wage rate. The difference between these two results gives the labor variation from this source. This, together with the losses on premium, determines the amount of labor variation from standard during the month. When working on a 100 per cent premium plan this will invariably show as a labor loss or a loss from standard, inasmuch as there is no opportunity for labor costs to be decreased. This is due to the fact that an operator is paid everything which he saves over a given time standard, and the labor costs do not vary. It is true that the departmental wage balance may show a gain, but in practice such gains are always offset by the labor losses.

Treatment of the Labor Variation

The labor variation is handled in the factory ledger under the same account as is the productive pay-roll which would probably be the Work-In-Process account or Finished Stock account if both are maintained. If a labor loss has been incurred, it indicates that the standard labor cost used in the cost figures has not been high enough, and that the cost used in the cost of sales has been too low by the amount of the labor variation.

The work-in-process inventory is reduced by the standard cost of sales, and if the cost of sales used was too low, it will not reduce the inventory sufficiently to place it on an actual cost basis. Pay-roll has been charged into the Work-in-Process account at an actual cost figure and in taking labor cost out of the inventory by means of standard cost, which is different from actual, it leaves an unaccounted balance in the inventory.

In operating a factory ledger on the standard cost basis it is necessary to keep the perpetual inventory figures on a standard basis. Since the inventory has been charged with pay-roll which is higher than standard cost, it is necessary finally to reduce the inventory by the amount of the labor variation in order to put the inventory on a standard cost basis. With this in mind, it is necessary to bring the labor variation on to the factory ledger as a credit to work-in-process inventory, and a charge against the General Ledger account. These variations when carried to the general ledger are used as a credit to the Factory Ledger account and a charge against cost of sales.

Overhead Variations

The next element of variation which occurs through the use of standard cost is that of burden, due to using a standard rate of overhead. This has been used for a number of years, as many accountants, recognizing the limitations of using actual overhead in the costs, have used a fixed overhead rate which is the same thing as the standard rate of overhead used in standard cost. The variation from this source is termed "over- or underabsorbed burden".

Inasmuch as the figures for standard overhead have been carried into the completed standard costs and these standard costs used to compile the monthly cost of sales, the cost of sales is incorrect by the amount of over- or underabsorbed burden. This is also true when operating a factory ledger where the inventory is reduced by the cost of sales. The inventory is built up from actual expenditures made for the Inventory account and the costs which reduce the inventory must be on the same basis as the costs which built it up.

In order to make this building-up and decreasing process equal, it is necessary to adjust the Inventory account monthly. If the final figure on burden at the end of the month has shown an underabsorbed figure, it means that the standard cost charged into the inventory was too low and the inventory must then be arbitrarily reduced by the amount of this underabsorbed burden and the general ledger be debited. This entry when reaching the general ledger clerk, is handled as a credit to the factory ledger and debited to cost of sales. Through this means, cost of sales is increased to a point which puts it on a basis of real cost and permits the actual profit for the month to be obtained.

The method of taking care of variations from standard cost described above may seem complicated. This is particularly true in the case of material variations and labor variations. Overhead has been handled in this way for so long that accountants are familiar with it, and if they will simply consider the variations from standard on material and labor is really over- or underabsorbed material and labor costs, and is handled exactly as is over- or underabsorbed overhead, it should tend to simplify the matter.

Control of Costs—Weekly Labor Analysis

The control of costs through standard cost has been discussed to some extent in other articles, as in the case of the daily labor reports which show exactly what each operator is doing each day; what he made or lost in premium on each day.

Another report which is of interest in showing how labor may be controlled, is a weekly labor analysis such as shown in Table 2. In this report which is

sent to the factory manager and to any others interested, is given the showing for each productive department for the week, as well as totals for the plant as a whole. Under the first column which is "Set-Up-Time," is indicated the amount of time spent by the operators in setting up the various jobs which they are running. Inasmuch as the setting up of the various jobs is not included in the premium rate, and is a day-work operation, it is necessary that the foreman be informed not only daily, but at the end of the week, how much his set-up time amounts to.

The next column, "Indirect Hours," shows supervision, repairs to the product, tools, machinery, etc.

The next column, "Day-Work Hours," shows the amount of time spent on so-called day-work operations, or in other words, the time spent on productive operations on which a premium time has not been established. It is in this column that the time-study department is particularly interested inasmuch as it is an object to keep as great a percentage of hours on premium as is possible.

Under the next heading, "Time Allowed," is shown the premium time allowed on the various operations which have been worked on premium during the week.

The next column shows "Time Taken" on these premium operations, and by subtracting one from the other, it indicates the amount of time gained by the operators of that department.

The next column shows the "Total Productive Hours," which is obtained by adding the day-work hours and the time taken on premium operations.

The next column shows "Indirect Hours" which is a total of the set-up time and indirect labor.

The "Premium Rate" of the next column is determined by dividing the time taken by the time allowed, and indicates the per cent gained over standard, or in other words, indicates that the operators as a whole in any given department, such as department 2, for instance, have gained 31.2 per cent above their day ratings, or have beaten standard by 31.2 per cent.

The amounts of the next column, "Per Cent of Hours on Premium," are obtained by dividing the time taken on premium jobs by the total productive hours which in the instance of department 2 equals 58 per cent.

The figures of the next column, "Percentage of Hours Indirect," are obtained by dividing the total hours, as obtained by adding the total productive hours and total indirect hours, into the total of the indirect hours.

The "Per Cent of Set-Up Hours to Productive Hours," of the last column, is obtained by dividing the set-up time by the total productive hours.

In the lower section of the report are the various summaries of the plant as a whole. Section 1 indicates the per cent of hours on premium, less departments 19 and 20. Departments 19 and 20 are assembling departments and include in their work operations which, while of a productive nature, are so complicated that it is impracticable to rate them on any other basis than day work. And inasmuch as the time study department is responsible for this figure, these two assembling departments are omitted from this calculation.

Under section 2 is shown the percentage of hours on premium including these assembling departments, and which shows the actual condition in the plant as a whole. Section 3 indicates the total premium rating for the plant and shows that, taking the plant as a whole, the premium operators are doing their work in 34 per cent less time than is asked for by the standard.

Section 4 simply shows the per cent of the indirect hours to the total pay-roll hours.

TABLE 2. WEEKLY LABOR ANALYSIS. WEEK ENDING NOVEMBER 24, 1923

Dept. No.	Set-Up Time	Indirect Hr.	Day-Work Hr.	Premium		Total Prod. Hr.	Total Indirect Hr.	Prem. Rate	Per Cent Hr. on Prem.	Per Cent Hr. Indirect	Per Cent Set-Up Hr. to Prod. Hr.
				Time Allowed	Time Taken						
2	18.95	104.10	44.40	80.54	61.40	105.80	123.05	131.2	58	54	17.9
3	51.00	190.40	48.40	422.18	373.05	421.45	241.40	113	89	36	12.1
4	26.40	115.75	37.10	403.60	315.90	353.00	142.15	128	89	29	7.5
5	.....	176.65	36.50	763.30	540.20	576.70	176.65	141	94	23	.....
6	3.30	153.45	42.00	409.29	276.05	318.05	156.75	148	87	33	1.0
7	21.35	71.40	8.50	291.24	220.55	229.05	92.75	132	96	29	9.3
8	5.15	56.30	118.30	124.46	94.95	213.25	61.45	131	45	22	2.4
9	24.55	125.55	40.05	546.48	422.05	462.10	150.10	129.5	91	24	5.3
12	3.45	134.35	.....	572.20	387.20	387.20	137.80	148	100	26	0.9
13	.....	586.90	23.30	792.22	597.65	620.95	586.90	133	96	49	.....
14	.....	.....	.....	94.68	86.90	86.90	.....	109	100	.....	.....
19	3.10	353.05	163.05	1,250.11	883.80	1,046.85	356.15	142	84	25	0.3
20	.....	231.05	332.40	763.08	590.65	923.05	231.05	129	64	20	.....
29	0.85	672.85	49.70	1,613.92	1,216.95	1,266.65	673.70	132.5	96	35	0.1
34	80.45	67.90	7.45	535.62	375.85	383.30	148.35	143	98	28	21.0
41	.....	87.95	.....	395.33	300.95	300.95	87.95	131.5	100	23	.....
42	.....	0.45	.....	124.01	95.55	95.55	0.45	130	100	.....	.....
46	.....	.....	17.40	131.34	82.30	99.70	.....	159	82	.....	.....
68	.....	238.70	125.00	311.82	250.90	375.90	238.70	124	67	39	.....
	238.55	3,366.80	1,093.55	9,625.42	7,172.85	8,266.40	3,605.35	.....	.....	.....	.....

(1) Total D. W. Hr. less 19 & 20 598.10	Total Premium Hr. less 19 & 20 5698.40	Per Cent of Hr. on Prem. less 19 & 20....91
(2) Total D. W. Hr. 1093.55	Total Premium Hr. 7172.85	Per Cent of Hr. on Premium 87
(3) Total Time Allowed on Premium 9625.42	Total Time Taken on Premium 7172.85	Total Premium Ratiog 134
(4) Total Indirect Hr. 3605.35	Total Pay-Roll Hr 11,871.75	Per Cent Hr. Indirect 30

Considering the standard cost system from the standpoint of the managerial and financial heads of the business, it allows operating statistics of almost any kind to be obtained with but little difficulty, and the figures so obtained are so nearly accurate as to inspire confidence and afford a reliable working basis.

The system outlined in these articles has been in actual operation for the past two years and is giving the utmost satisfaction, not only to the management and board of directors, but to the foremen and to the operators themselves.

In closing the writer would only suggest that where this method of accounting and control is not in use it be investigated. If this is done, there is no doubt but that its greater operating possibilities will be disclosed. It not only means more money to the company using it, but means more satisfied operators and a better condition throughout the plant as a whole.

Fiber Shipping Case Economies

Important Features of Value to Every Industrial Plant

By WILLIAM A. VOLLMER

Sales Promotion Manager, Robert Gair Company

Index Number
658.78844 Shipping cases

PERHAPS the outstanding superiority of American business over older countries has been in the improvement of distribution methods. The turn toward package merchandising which had its real inception in 1897, while increasing the greater public demand for branded goods, also resulted in so much greater facility of distribution that the two forces acted together in spreading the sale of all manner of products. Of course, the wide spread of railroad systems and the remarkable development of freight hauling in all the advances of its technique were essential before goods could be rapidly and widely delivered. But the package idea plays a big part nevertheless.

FIG. 1 FIBER CASE STORAGE IS ECONOMICAL OF SPACE

With the rapid extension of the package idea, came the question of packing for shipment. There must be standard units purchasable in large quantities and as uniform in character as the other elements of packing. The fiber case, hitherto in the experimental stage, attracted the attention in this connection of both shippers and paper-board manufacturers, and since 1906 has had an astonishing growth in public acceptance.

In the endeavor to point out some factors of the economic value of this form of shipping case, it is perhaps worth while to discuss, first, certain general phases which bear upon it.

Though we, in the United States, may have developed efficiency in many fields of performance, it cannot be said that in all cases we have paid strict attention to the incidental waste. Fortunate in enormous forest resources, we have been so lavish in their destruction that the *most sanguine* experts report that at the present rate of consumption the existing lumber supply will become exhausted in 150 years. Even the casual visitor to Europe may be struck by the difference in the attitude toward forest preservation and the destruction of forest products. American soldiers casually burning boxes seemed to the French faggot-gatherer to be committing a sacrilege. Yet that is the normal fate of most of the wood cases which make up the vast total shipped annually in this country. It may take some stress of sacrifice to teach America the spirit of conservation.

Meanwhile, however, the use of fiber is accomplishing this very vital saving. There is only about 10 to 15 per cent of new wood product used in the fiber case as compared to the lumber in the wood box of a like size. Best of all, however, the fiber container is not attractive to the builder of bonfires and certainly not useful in kindling. At the same time it is the most satisfactory form of waste for re-conversion into paper-board for new boxes. The improvement in the organization of waste collecting agencies and the greater public understanding that waste paper can bring income, is daily acting as a force in the conservation of timber which certainly is desirable from many points of view. Interesting statistics might be obtained relative to the amount of income received by the management of our big office buildings from the sale of paper waste.

FIG. 2 MECHANICAL HANDLING IN THE PACKING OF LUX

Knocked down cases are set up, filled, and put on a conveyor which runs them by a weighing scale, through a sealer and down chutes to the shipping-room.

The shipper is concerned with but two primary problems. What packing can he use to deliver his goods in satisfactory condition, and what will be the least expensive container, both from the point of view of cost and packing expenses? No claim has been made by fiber box manufacturers to the universal suitability of their products for all shipments. In the fields, however, where such cases have become the standard of shipping practice, as well as where they are rapidly becoming established, they have a demonstrable superiority, and occasion very significant savings. It is our purpose to point these out categorically and give certain characteristic instances.

First of all, a word will be given upon the recent developments in research to establish manufacturing standards and the methods of testing containers for their suitability to stand the stresses and strain of transcontinental shipping.

When the fiber case passed beyond the experimental stage and its general use in transportation was extended, it became subject to the regulation of the Classification Committees of the Interstate Commerce Commission. Two types of boxes had sprung into use: One was the corrugated case made of two "jute liners" separated by a thin sheet of strawboard fluted or corrugated. Strawboard has great resiliency and with study, the proper angle of corrugation was arrived at. A cross-section of this board shows two tough

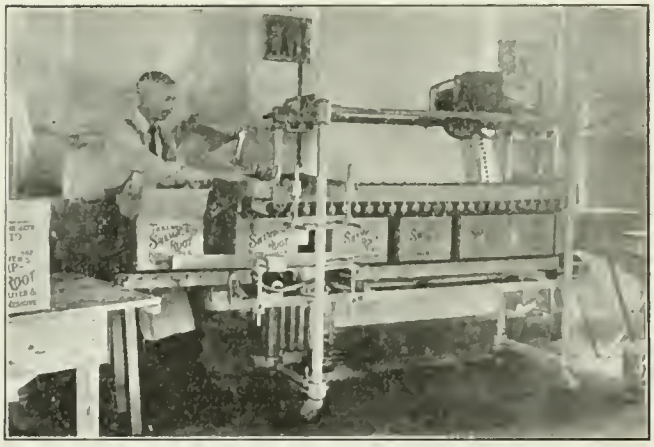

FIG. 3 A SEALER FOR FIBER CASES

pieces of fiber-board held apart by a row of arches working exactly as the truss in bridge construction, to provide the maximum amount of support with the minimum amount of material. Due, then, to the material and the construction, a sheet of corrugated board has great resiliency and acts as a shock absorber to blows received in transit.

Solid fiber cases use the same "liners" of fiberboard or pulpboard, combining them by pasting to several plies of chipboard, which makes a solid filling in place of the corrugated strawboard. This laminated paper construction, as it is treated by the manufacturer, makes a particularly tough and leathery box strongly resistant to puncture from contact with sharp corners.

Rule 41 of the Consolidated Freight Classification prescribes the specifications of material to which the manufacturers must conform in making fiber boxes. Liners of definitely prescribed thickness must be used in each of the standard grades of fiber cases. The resistance of the combined board must show a certain minimum bursting test of a definite number of pounds pressure to the square inch for each type of material used. There are also dimension and weight limits stated for boxes of each grade of board. Each boxmaker puts his certification stamp upon each box to show that these regulations have been complied with. It must not be supposed that the certification means that all boxes are therefore uniform; conscientious boxmakers manufacture goods considerably in excess of the minimum requirements.

Standardization of Packing

The chief reason for touching upon this phase of the subject is to point out that the fiber package is subject to a definite amount of standardization. It is made of materials which can be controlled to almost negligible variability. Hence when the right size and shape of package have been determined upon, it can be expected that the future supplies will be uniformly satisfactory. It is, of course, impossible to control native, elementary manufactured products, such as lumber, to anything like the same degree of consistency; hence certain tests for standards show a much wider variation in wood boxes and prediction cannot be made with the same expectation of constant performance.

Having a raw material which can be kept within standards of scientific exactness, and manufacturing it into boxes under controlled standardized processes, there was need of testing methods which did more than check the material used in containers. Something had to be found which could test their utility function and their performance prior to the actual risk of shipment. The so-called United States government model drum-tester has accomplished this, so that now the suitability of fiber boxes for the individual needs of shippers can be developed through research, and, particularly important, the most serviceable interior packing can be judged through comparative experimentation. The first machine of this sort was devised by J. A. Newlin, who was in charge of the Forest Products Tests at the Madison Laboratories of the United States Forest Service. He conceived the idea for testing the strength of wooden containers of various types of construction, types of wood, and thickness, and also to test the holding power of nails. On each of the six sides of the hollow drum, which forms the drum-tester, cleats or battens are nailed. As a result of experimentation, these are so placed that they hold the box, as the drum revolves, until it falls first on one corner, edge, and side, and then on another in sequence, the drum automatically duplicating all possible shocks that a package may have in transportation. After the drum was installed at the Forest Products Laboratory, it was adopted by several large users of packages and one or two manufacturers of cases. These were adopted some time in 1919. In many cases where drum tests have been made, sample actual shipments of similar packing were also made. This check has

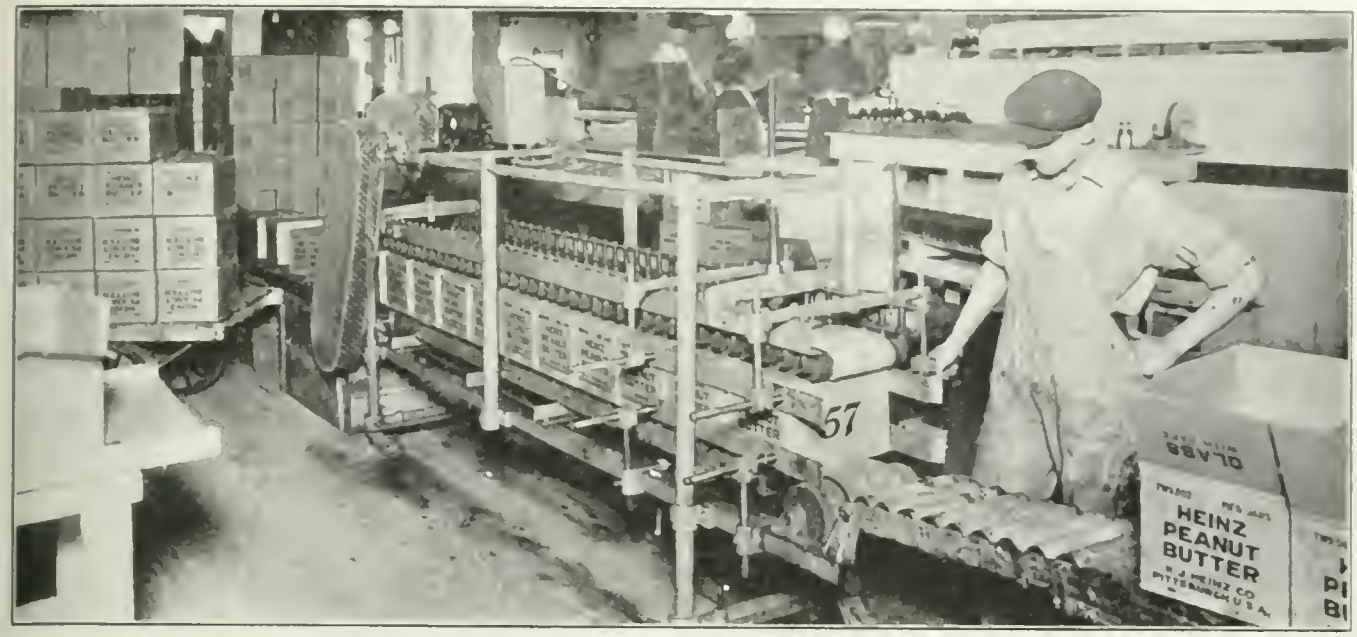

FIG. 4 A SEALER FED FROM A ROLLER CONVEYOR

been given by almost every owner of a drum-tester; and actual use substantiates the reliability of the laboratory test.

Having endeavored to sketch the theory and development of fiber cases, let us take up the discussion of fiber case economies which have been established through their use. In a loose acceptance of the terms they fall into two classes of savings over earlier methods of boxing—savings in distribution and savings in production. Under the first heading is the primary saving of investment in shipping material. Fiber cases are considerably less expensive than wood. Box for box, depending upon size and construction there is a reduction of first cost often aggregating 50 per cent. The second saving is in freight. Fiber cases weigh from 50 to 75 per cent less than wood, the variation depending chiefly upon size. This produces a cumulative saving that appears at three stages in the sequence of transportation. The first reduction is in the haul from box manufacturer to the packer's plant. Fiber boxes average from 8,000 to 10,000 to a car, can be loaded to fill the space entirely, and make a weight saving on each shipment that is considerably worth while. Since, as a rule, the big fiber box manufacturers are located near the market they serve, there is in many instances a reduction in length of haulage over that required to ship box lumber from the wood-working base—usually placed near the forest regions and away from manufacturing centers.

When the packer's product is shipped to his wholesaler's distributing point, this freight-weight-saving is again operative; so also for the third time, from the jobber to the retailer. This triple saving can result in commodity selling prices materially lower than are possible with wood cases, a very helpful thing on such highly competitive markets as exist today.

The second class of savings, which we have called production savings, occurs in facilitating the flow of manufacturing processes in the economy of handling and in the reduction of overhead. Corrugated and fiber cases are complete units in themselves. They come in bundles which are very easily loaded on trains, unloaded at manufacturers' plants, and stored flat. See Fig. 1. In the space required to store 10 complete wooden boxes, a hundred knocked-down fiber cases may be placed.

Co-ordinating Speed of Production and Packing

There is another phase of this space-saving, which has to do with the processes of assembling. Even though the components of a wood box are in the form of shooks, some sort of carpenter shop is required to make the best economy of the material. There is always a certain amount of noise and confusion, which makes it necessary to have this last stage of the production process somewhat removed from the final operations of packing individual cartons, bottles, and the like. As has been previously indicated, one of the significant advances in package business is the remarkable development of automatic packing machinery. Unit containers are filled, sealed, weighed, and set up automatically with the use of minimum personnel and exceeding precision, at high speed. In order not too greatly to extend the area of the packing-room, there has been a problem in many industries to keep the packing of shipping cases up to the production speed of delivery at the end of automatic machines. Fiber containers, being complete units, can be packed at these machines, sealed, and delivered by the simple gravity or other form of traveling conveyors to the loading platforms and into the cars. See Fig. 2.

The savings incidental to the use of corrugated and fiber shipments are all greatly demonstrable in the individual experience of each user. There are general economic features, however, which, though no dollar and cents value may be placed upon them, nevertheless are just as important. By its smooth construction, having no rough edges, projecting points or wire binding, the fiber case is very easily lifted and handled.

Perhaps one of the most significant large-scale investigations of fiber in use that has been conducted by the government was a test shipment of canned goods which was conducted by the Commissary Department during the war. These cases were forwarded from America through the various rehandlings necessary to reach the base army depots. The investigator who accompanied the shipment noticed that at each stage, no matter what the character of the freight handler, he instinctively laid aside his baling hook when he came to the fiber part of the shipment. Recognizing the fact that he was free from personal injury in lifting the cases he used the extra care which is an outgrowth of his feeling of security. With the wood boxes, the instinct to protect his hands made the bale hook desirable and a consequent damage to the contents resulted. The repetition of this fact at each stage in the progress was definitely impressed on the mind of the investigator. The smaller, more compact units generally found in corrugated and fiber shipments also do away with much of the destruction that often occurs with boxes that are difficult to lift and hard to load. A rough, poorly-printed, nail-exposed package inspires a certain amount of animosity on the part of the handler, which induces baggage smashing.

An examination of accidents in the handling and nailing of wood boxes shows that they form a large share in industrial injuries. This is certainly a charge on industry, no matter whether it be taken care of by employees' liability insurance or not.

A word might also be said upon the question of pilferage. Study reveals the fact that most cases of pilferage occur where the damage may be concealed and the contents of a box removed without revealing theft. It is a considerable advantage of corrugated and fiber shipments that their fashion of sealing makes it practically impossible, if they are properly sealed, to get at the contents without damaging the case.

Machinery for Making Packing

Perhaps a word will be of interest on the automatic or semiautomatic equipment devised to make the packing of corrugated and solid fiber containers work with least effort and expense and the maximum amount of security. As has been said before, the packing-room in the average industrial plant where wooden cases were used for shipment, was formerly located at a distance from the machines due to the space required for the assembling of bulky, set-up boxes and the equipment necessary to fill them and close them. Most fiber containers are sealed with silicate of soda—due to the ease of its use, the added strength given cases so sealed, as well as its low cost—and many semiautomatic devices have been prepared. Where there is not considerable output, various auxiliary helps have been constructed to seal the bottoms of cases and presses to hold the tops in place, giving sufficient time to allow the silicate to set. Several manufacturers of sealing equipment have devised machinery, some illustrated in Figs. 3 and 4, which increases the usefulness of fiber cases.

Sealing machines are placed close to the point where packages are automatically delivered. This type of sealing machine is simple in construction and is easily operated by one male or female operator who seals both ends of the loaded container in one operation. Perfect adhesion is secured by the application of instant pressure to both ends of the container and to the top of the container, which is always the hardest end to seal. The pressure is obtained by means of a series of spring-pressed rollers exerting pressure through a flexible belt, which furnishes a yielding, yet constant pressure over the entire area of the top of

FIG. 5 THE STORAGE OF FILLED CASES ELIMINATES WASTE ROOM

the container and within the side walls. As the container enters the machine, it automatically starts a motor which operates the top and bottom belt, and these in turn draw the box under compression where it is held until the next container is prepared and likewise passed into the machine.

Machines have also been devised to apply lateral pressure against the outside flaps on the top and bottom of the container, thereby insuring the close jointure of flaps at the center, which is so necessary to a well-sealed container.

The labor-saving by the use of a sealing machine is quite apparent when one considers that all the work of sealing can be done by one operator, whereas it formerly required several to seal first one end and then the other end. Again, excessive handling is eliminated because the containers move away from the end of the packaging machine where they have been loaded, to the operator placed nearby who seals both ends of the container. They then start to travel away from that point and as they leave the end of the sealing machine, can be conveyed by belt or other conveyor to a loading platform or storage space provided in a distant part of the plant, without further handling or attention. See Fig. 5. This makes for conservation of space and permits the sealing operation to be done adjacent to the packaging machinery, which results in a continuous operation of packaging and loading. Operation speed is from 100 to 200 containers per hour according to the size of the case and its weight.

In small plants with a production of a few hundred filled containers per day a combination work table and sealing machine is provided which permits the operator to do her own packing and sealing. Larger

machines in graded sizes take care of larger outputs up to any required quantity per day, the size of the machine depending chiefly upon the length of the container and the output per hour. Such equipment as this, therefore, is productive of operation economies, and permits the substitution of laborers for the much more highly paid class of artisan needed for carpenter and wood box assembling work.

Where and in what manner can the purposive manager look for the incidental savings that accrue from the use of fiber cases? Perhaps a few concrete examples may offer suggestions.

Demonstration of Best Design

Fletcher's Castoria, a liquid in panel glass bottles, had been packed in wooden boxes of a superior grade, the dimensions of which were $13\frac{1}{8} \times 14\frac{1}{8} \times 6\frac{3}{4}$ in. These boxes weighed about 4 lb. empty and cost at the market price then obtaining about 23 cents. Each bottle was inserted in a combination of carton and wrapper, and six cartons of twelve bottles each were packed in the case, making a net weight of 38 lb. For experimentation, to demonstrate the best design of case, two styles of corrugated containers were made up. Both of these were composed of 200-test board with the inner cartons separated by corrugated partitions. One of these was so designed as to use the minimum amount of board. In this case the inner flaps did not quite meet. This, therefore, under the stipulation of the classification regulations needed top and bottom pads. The other was designed to have all flaps meet, and therefore needed no extra padding, under the rules.

These containers were tried out in competition in the United States Government Model revolving drum-tester, which demonstrated that either style of corrugated box stood more drops than the wood box and therefore since the cost was materially lower, the case with meeting flaps was adopted and has proved satisfactory in use. The economies discussed above, in reference to the facilitation of the flow of production operations from the automatic filling machines were made use of by the purchase of sealing equipment. The absolute savings show as follows: First cost, a saving of $6\frac{1}{4}$ cents a box or about 28 per cent. Freight —wooden box, gross weight, 42 lb. 10 oz.; corrugated box plus partitions 40 lb. 13 oz., a net saving of 1 lb. 3 oz., or $1\frac{1}{2}$ per cent of the weight. These are significant figures when one considers that they are to be multiplied by hundreds of thousands. See Fig. 6.

Another concrete instance is revealed in a test of containers for a 25 lb. can of shredded cocoanut, one of the products of the Franklin Baker Company. Containers of 0.100 solid fiber and 275.16 test corrugated fiber were designed and tested with the wooden box then in use. It is well here to state that the drum is revolved until the package being tested splits or breaks open, the number of revolutions being tallied until this occurs. The average result showed wood 128 drops; solid 120; corrugated 458. The corrugated case which was adopted permitted a weight saving of $7\frac{1}{2}$ lb. per case, a little over 20 per cent. The saving in cargo space in this instance, taking the outside dimensions of wood and corrugated containers, was 220 cu. in. or 8 per cent. See Fig. 7.

Corrugated Containers

A further characteristic case appears in the box designed for a maker of phonograph records. There are five sizes of containers in this instance, the wood boxes carrying five different units of records varying in number from 400 to 100. These cases were made of wood shooks assembled in the plant. The engineer of the fiber box manufacturer recommended one standard container to substitute for these five sizes. It was to carry 100 records packed in units of 10. A variety of the severest tests both in the drum and in actual usage demonstrated the satisfactory carrying capacity of the corrugated case, and a comparison of the weight and cost savings appear in the following schedule based upon a unit of 22,000 cases:

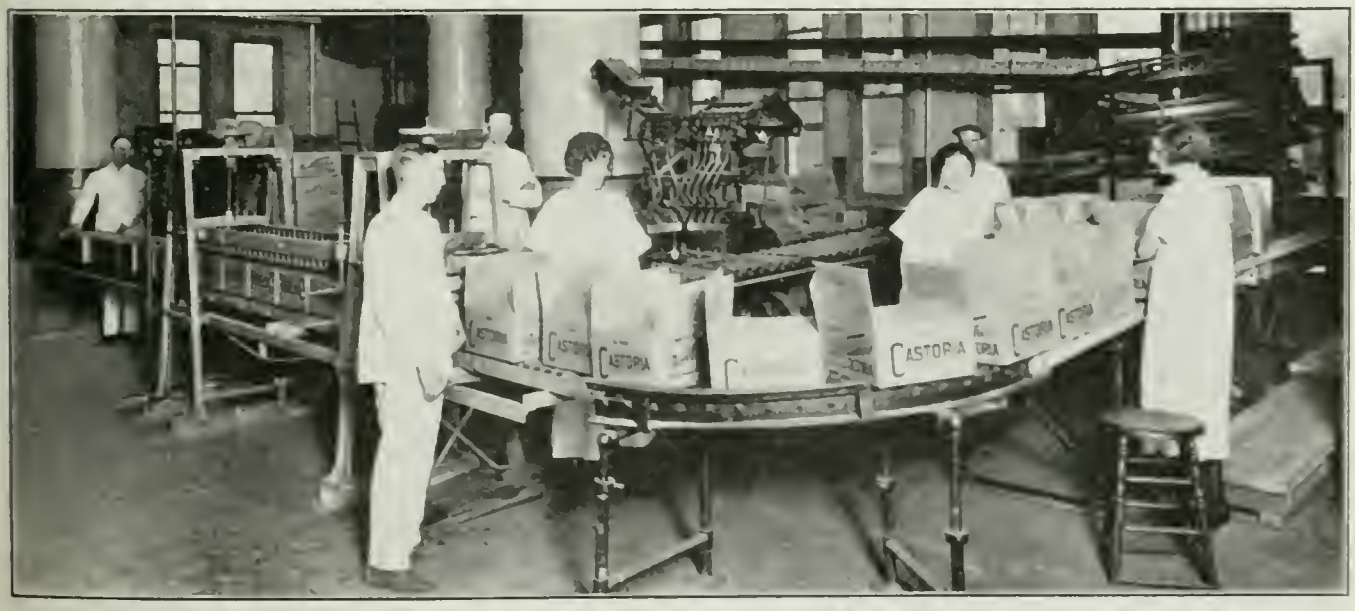

FIG. 6 A COMPLETE CONVEYOR SYSTEM FOR PACKING AND SEALING CASES OF CASTORIA

	WOOD		CORRUGATED	
	Initial Cost	*Tare Weight*	*Initial Cost*	*Tare Weight*
Box A	$0.88	25 lbs.	$0.125	2.5 lbs.
Box B	0.67	23 lbs.	.....	...
Box C	0.59	18 lbs.	.....	...
Box D	0.35	11 lbs.	.....	...
Box E	0.19	10 lbs.	.....	...

Besides the notable first cost reduction this aggregates a decrease of nearly 315,000 lb. tare weight on the 22,000 cases!

So much for a comparison of savings in industries that involve articles subject to damage in shipment. It is worth while here to enumerate some other points of economic value. The American Wringer Company shipped clothes wringers in varying quantities in large heavy cases weighing 90 odd pounds. They were protected by miscellaneous wrapping and the six or more wringers had to be unpacked on the receipt of the consignment and stored in odd sections of the dealer's shop. There was no display value and a certain amount of deterioration in appearance due to dust collection. Research led the box manufacturer to pack each individual wringer in a corrugated fiber carton well printed with the company's brand and a brief description of the contents. Three of these cartons went into a corrugated case. This was subjected to the unusual strain of being hurled down a long flight of concrete steps ending in a landing. It survived the shock, keeping the contents intact, but the wooden case under the same test flew into splinters, in the midst of which were broken sections of clothes wringers. Convinced of the decreased cost of packing and also the efficiency, the company still had some doubts of its sales effect. Would the dealer buy less when the size of the shipping unit was decreased? Nevertheless, the trial was made.

FIG. 7 A DRUM-TESTER AND FILLED CASES WHICH HAVE BEEN TESTED

The number of drops given is marked on each container.

Almost immediately sales jumped. The neat, easily handled container was used as part of the store and and window display. The package attracted attention; it protected the goods. The year's sales proved conclusively that the new container instead of deterring sales by permitting smaller unit orders, stimulated sales because it increased the number of dealers who could afford the investment and it did not decrease the size of the large dealers' purchases. The sales manager is most enthusiastic over the results and places a large share of the increase directly upon the change of package.

This idea of forcing sales by increasing the minimum purchase unit was the fallacy which long held back sugar, flour, and such articles from being distributed in individual packages instead of bulk barrel or bag units. The astonishing spread of package sales mentioned at the beginning of this article proved beyond question the wrong psychology of this opinion. The profits of quicker turnover, wide sales distribution,

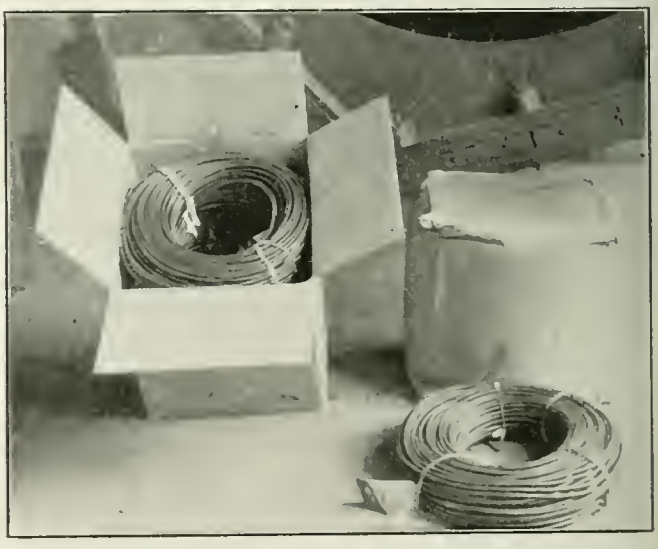

FIG. 8 CASES OF WIRE WHICH HAVE BEEN TESTED

and greater stimulation of public demand are based upon business laws which do not apply alone to the chain and five-and-ten-cent stores; they work in exactly the same fashion with all businesses. Every day manufacturers are realizing this and by decreasing large bulky shipping units are achieving an elimination of loss and damage in transportation, and at the same time opening up new markets. A manufacturer whose shipping unit was 10,000 ft. of insulated wire weighing 146 lb. has recently changed this unit to 5,000 ft. coils weighing 73 lb. This permits use of a fiber case, as shown in Fig. 8, with just such economies and advantages as have been outlined.

Often a re-design of shipping methods, and the substitution of corrugated and fiber for crates, may require inner packing to such an extent that the total cost of the fiber shipping container is greater than was its predecessor. Notwithstanding this, however, there are economies worth mentioning. We may cite as an instance in point the Simmons Bed Company, a large distributor of metal beds. The merchandise was encased in excelsior wrapping to protect enameled sur-

faces from scratches. With the shipping method then used, serious losses were found to exist which were results of improper protective packing. The new fiber box, substituted for the old method, made it possible to obviate the injury to surface enamel and to put the beds up in a well-printed fiber container which had considerable advertising value. The elimination of claims and damages, which were not chargeable to the carriers, meant a considerable saving. Figs. 9 and 10 also illustrate instances where fiber cases mean safe delivery of contents.

The facility with which corrugated and fiber cases

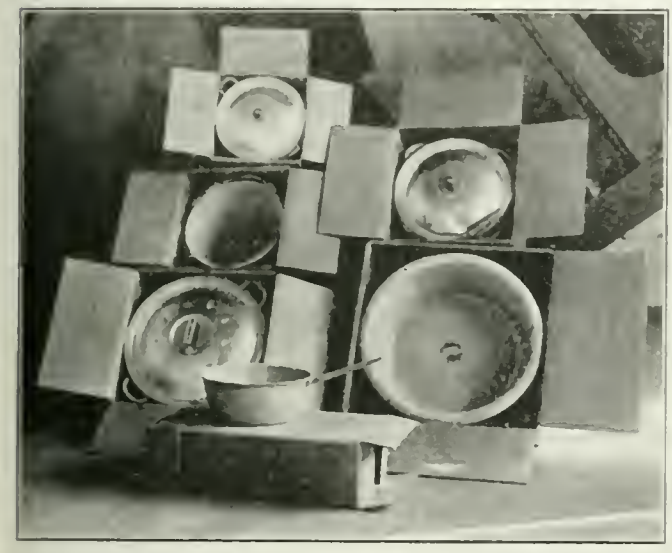

FIG. 9 FIBER CASES ARE SUITED TO KITCHEN-WARE SHIPMENTS

may be printed in attractive colors and easily recognized names and brands fits them for use in the campaign which transportation companies have been conducting for a long while to eliminate the great losses of shipments due to the improper marking of containers.

The importance of standardization within industries and individual manufacturing institutions has been challenging government attention. The fiber case provides much opportunity for realizing the economies which fall under this head. Strangely enough, for all our advancement, precedent in the form of illogical trade habits is one of the biggest obstacles to the achievement of considerable economies. In certain industries the arbitrary unit case shipment is, we shall say for argument's sake, 50 lb. packages. There is a refusal to change, even though a 48 lb. unit better comports with a square fiber case. "Because the dealers have always had it that way," is the excuse. Certain other industries have miscellaneous standards and packers refuse to change because their bookkeeping system would have to be changed.

A very significant example of standardization in packages which has accomplished saving beyond estimation is the case of the canners. Cans, labels, and shipping cases have been limited to a few definitely determined standards uniform for the whole industry. This permits the manufacturer to stock the material and make a manufacturing saving on standard quantity runs. It saves the smaller canner money by permitting him quantity price through buyers' clubs. Be-

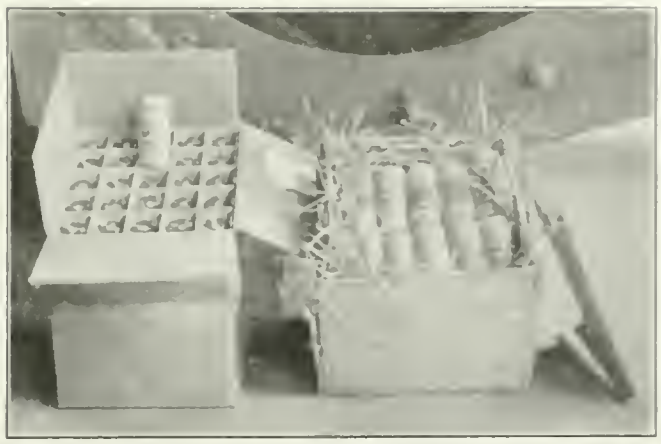

FIG. 10 INTERNAL PARTITIONS MAKE POSSIBLE A CLEAN AND SAFE CASE

yond all this, the uniformity of manufacture and the recognized requirements result in establishing a market price upon packing materials. This diminishes the likelihood of erratic price fluctuations. There are other great industries where similar good work can be done.

In the case of individual houses where many items fill up the line these same principles applicable to whole industries also obtain. One pharmaceutical house has added a large number of products in collapsible tubes to its line in the last decade. Whether because of the design or because of lack of central control, each differs slightly from its fellow by some small fraction of an inch in dimension. This means cartons all of different size, and a different size of shipping case for each product. Slight change would permit using one size of container for all products. Beside the cost saving, this would mean many advantages in stockroom handling and facility of inventory. Another company which has an affiliated line of products has carefully revised all containers and no new item is added without consideration of the whole list. One shipping case is so designed that by the proper use of partitions it serves for both bottles and cartons. This means a considerable cut in the packing bill. A similar opportunity is open to coffee and tea packers who follow one leading distributor. This company, instead of a random selection of one-half and quarter lb. units, made the proportion of the lesser boxes in such relation to the greater, that the regular shipping case could carry both pounds, halves, and quarters, and an assortment.

It is not possible in the space of this article to do more than hint at salient features of fiber case economies. It is hoped, however, that some features of the subject will provide food for thought and investigation. Under such competition as exists today it is often the small item of eliminated waste that makes for supremacy in any given market. It is hoped that we have pointed out how thoughtful activity in the fiber case industry has resulted in demonstrating in a rapidly increasing field that fiber cases effectually perform this primary function of delivering goods safely and free from loss; secondly that with the advantage of being a manufactured product, all the materials of which are subject to control and standardization, they can be so designed to do this at the least possible cost.

Planning Purchases to Fit Production

Index Number
658.78 Materials control

DAYS were being lost here and there—in some cases even weeks—in getting our raw material on the job. If the material was in our storeroom we had no difficulty, for then we needed only to call a hand-truck. The greatest difficulties were caused by materials that had not yet arrived at our plant from the factory where they were made. Should not these vendors and their factories give us better co-operation? Was there not some way to make them nearly as dependable as our own storeroom? True, they are outside firms not under our ownership nor control. In the big economic scheme of things, however, they are an important link in the same chain of production of which we are another important link. Such plants may be hundreds of miles away, yet are in effect, parts of our plant.

We did not believe in "shopping" for the materials of which we used a great deal. We kept our eyes and ears open, but we needed to establish dependable sources of raw material with channels continually open from them to us. We realized that we did not know enough about our sources of supply. At least, we had not used our knowledge to the maximum, so we set about to remedy this lack.

Schedules which co-ordinate purchases and production have effected savings at points where every manager knows the opportunity for savings exists. There is no need to rehearse the elements of waste and cost that lie in lack of material. Every factory executive knows them—postponement of the starting of a job; disorganization of production plans, or impossibility of making good plans; discontent of workers; increased overhead of supervision from last-minute change of plans; tying up working capital in a supply of parts but with one essential part missing; and so on. The material schedule is not perfect, and never will be, but we have saved many delays and much expense by making the purchase planner a middleman linking together the production department and the sources of materials.

Study of Facilities of Each Factory

Our supervisor of stores made a trip to each factory from which we were likely to receive repeated shipments. The first trips were so productive of good results that they are now a matter of course.

The supervisor makes a study of the facilities of every factory, the size and daily capacity of each machine, the schedule on which material usually moves from process to process, how much that schedule can be speeded up by planning, how the other factory in its turn gets its own raw materials, and any other circumstances that are likely to affect the stream of material to us. Such a trip is easily arranged at the time when the source factory is endeavoring to close a contract. The resulting data are arranged in tabular form and kept permanently in the stores supervisor's desk for ready reference.

Thereafter, when about to place a big order with this vendor, we inquire which of his hammers or machines are to be used in making the order. The source factory needs these data for its own intelligent planning, and has no objection to giving us the information. Then our material planning department lays out a 31-day diagram of the vendor's factory operations just as if his factory were a department in our own plant. This diagram records down the left-hand side the reference numbers of the drop-hammers or other production units of the source factory, sometimes using the vendor's own serial numbers and sometimes using original numbers.

Suppose we order 16,000 forgings to be made according to our blue-print No. 5,237. The vendor tells us that his hammer No. 4 will be assigned to the work. We mark in the proper date square opposite hammer No. 4, "16,000—5,237". Our records of his plant tell us that this is a 2000 lb. hammer of the right sort for that work, and that the daily capacity of the hammer is 4,000 of these pieces. So the hammer will need four days to do the 16,000. A wavy line in black ink is drawn over the four daily spaces next preceding the agreed shipping date. Thus the purchase planner knows when manufacture of the material should start.

Daily Production Report

The vendor—in this case the forging manufacturer—sends us a daily report of production of all our orders, specifying after each quantity the reference number of the order, the blue-print number of our drawing or his, and anything else necessary to enable us to identify the material and the order in case we have more than one order in his shop at the same time. He needs these figures himself, and they are a great help to us.

We transfer his figures to our own diagram of his production of the order, paralleling our wavy lines in the four-day space with green lines to indicate how far this material has been manufactured. We can tell whether the agreed schedule is being lived up to.

If he does not report the starting of an order, we send him a query. Thus we correct the delay before it is too late to get the work back to its original schedule.

The vendor's progress report of manufacture contains a space to record the steel on hand at the source factory for making our order. In some cases it is wise for us to know not only that the vendor's factory has the will to make our order, but that it has the steel to make it with, otherwise his factory, his machines, and his promises would be of no avail to us. He co-operates with us by reporting the steel he has set aside for us.

This procedure saves us many costly delays in starting our own production. It saves maintaining large quantities of 9 finished parts awaiting the arrival of the remaining part of a 10-part assembly. Once our only insurance against such part shortage was to order everything several months ahead and store it in our plant. This method took space, and tied up a great deal of working capital. Co-operative planning with the vendor shortens this period and releases a corresponding amount of capital for useful application.

Pricing Policy in Relation to Financial Control

"Tuning up General Motors"—Article Two

By DONALDSON BROWN

Vice-President, General Motors Corporation

Index Number
658.14 Financial control
338.85 Price analysis

THE problem of modern industrial management holds two aspects, quite separate and distinct in basic character. On the one hand lie the governing considerations of return on investment and protection of capital employed; on the other, the correlated considerations of operating procedure and detail. In the broad sense the interests of capital are represented by a board of directors and such subcommittees as may be constituted having jurisdiction over policies; while authority and responsibility for operating results are lodged with executive officers and subordinate departments.

In this significant article is outlined a method of price analysis which, though resting upon a theoretical basis, is wholly practical. General Motors' theory of pricing has this definite objective: to gain, over a protracted period of time, a margin of profit representing the highest attainable return commensurate with capital turnover and wholesome expansion, with adequate regard to the economic consequences of fluctuating volume.

Sound policies must be founded upon a knowledge of the nature and characteristics of the individual business, and the point of view of the executive in actual contact with the operating necessities and difficulties is essential. Intimacy with the daily operating problems leads to intelligent decisions of policy, and thus it is that organization often takes the form of committee management, where questions of policy are dealt with by the board of directors or a representative committee comprised of departmental executives. This form of management possesses the attribute that the departmental executive is called upon to administer policies in the formulation of which he has had a direct voice, and may be said theoretically to afford the maximum of opportunity for the coordination of the two aspects of management. Practically, however, it always renders more difficult the differentiation between questions of policy and operating procedure. Policies should be dealt with from an impartial understanding of the operating aspect, and in the exercise of the dual function it is difficult for the individual to divorce himself from the departmental viewpoint.

Questions of policy merge themselves with questions of operating procedure so that frequently it is difficult to disassociate the two. In a moderate-sized business where ownership and management are identical, and where the departmental executives are in actual contact with the detail operating problems, there may even be no conscious segregation of the broad questions of policy. Decisions are made for executive action which involve a composite consideration of all of the elements involved, and the interests of capital are served by direct control. In modern industry, however, where economies of manufacture and distribution are derived from large-scale operation, ownership and management cannot be identical. Capital is derived from various sources and from many stockholders identified only to a limited extent with management.

The magnitude and financial strength of General Motors is such that it is enabled to effect great economy in manufacture and distribution. Its organization is designed so that these advantages may be enjoyed without the sacrifice of co-ordinate control so often experienced in big business. The corporation comprises a number of divisions which manufacture and sell passenger cars and commercial vehicles of non-competitive classes, and numerous divisions whose production of component parts and accessories is sold both to General Motors divisions and to outside automobile companies. Each division is equipped with a self-contained organization having complete jurisdiction over manufacture, sales, and finance, subject to control from the central authority. The ordinary, everyday questions of policy, embodying even such important matters as production schedules, inventory commitments, design of product, and methods of distribution, are left ordinarily within the consideration and decision of the divisions themselves, under certain general limitations, and in every way the men on the firing line are inspired with a sense of responsibility for results.

The central organization embraces talent in automotive engineering and research, and experts dealing with important problems of improved methods in manufacture and distribution, all of whom serve in a more or less advisory capacity. Apart from these important adjuncts, and certain necessary activities in finance and accounting, law, and related matters, the central organization deals almost exclusively with questions of policy. The president is general manager of the corporation in fact, but controls the operations by the establishment of principles and the interpretation of

policies, and refrains from entering into questions of operating detail except in cases where the two are inseparable. The executive and Finance Committees, as active bodies subject to the board of directors, have final jurisdiction over the entire business through the enunciation of policies and by direct action in matters involving essential points of policy.

This brief description of the character of organization is given as illustrating the fact that the management of General Motors is such as to afford a peculiarly good opportunity for segregation of the broad questions of policy which are of fundamental concern in the interests of the stockholders. One phase of the problem lies in the direction of formulating policies in such terms as to render them understandable, so that they will actually govern executive action and at the same time not hamper the exercise of initiative on the part of those responsible for operations. It is to this phase of the problem that the present discussion is directed.

One of the most important necessities of policy has to do with financial control. Expansion must be limited within the resources of capital, and in a corporation such as General Motors, the available capital must be directed into channels that hold the greatest promise. Capital must be derived from undivided profits or from the sale of securities, and the amount available from these sources must be measured in the light of its economic cost, with due regard to dividend income to which the stockholders are entitled. General Motors employs a very comprehensive scheme of forecasts of the prospective earnings and capital position of the corporation, to supply the basis of financial control.

Control of Capital by Forecast

Space does not permit the presentation of a complete outline of the forecast scheme. A brief description is necessary, however, since it is through this that the Finance and Executive Committees are kept informed and thus enabled to exercise such control as may be needed from time to time.

In December of every year, each division is required to present an outline of its view of probable operations for the succeeding year, embodying estimates of sales, earnings, and capital requirements. These outlines are in three forms, i. e.: "pessimistic," representing a minimum expectation; "conservative," representing what is considered a likely condition, and "optimistic," representing what the name implies, with production and sales capacity as a limitation.

Obviously in a business such as the automobile business it is not possible to forecast conditions accurately so far as twelve months ahead, and these annual compilations are not accepted as a basis of commitments, but, with due allowance for elements of error, they are of valuable assistance in guiding the general plans and policies of the corporation.

Definite forecasts are submitted monthly, on the twenty-fifth of each month, by each division, covering the current month and the succeeding three months. These forecasts cover sales and production each month, and indicate the amount of investment at the end of each month in plant, and working capital items, and also outstanding inventory commitments. If these forecasts are accepted they constitute authority for each division, respectively, to proceed upon the manufacturing schedule and to make forward commitments for materials up to the requirements of the forecast, in the judgment of the division manager. Special authority is required from the central office to cover any commitment beyond the requirements of these authenticated forecasts.

Forecasting and Price Policy

All forecasts, as submitted, are scrutinized by the central office and compared with current and past performance, attention of the proper officials being called to any abnormalties or marked deviations from what might be deemed a conservative sales expectation. Experience has led to the establishment of standards of working capital requirements in relation to volume of business and the forecasted investment in receivables and inventory are carefully checked against such standards, allowance being made for seasonal fluctuations. The tendencies of manufacturing costs and of selling and administrative expenses are observed, and profits are analyzed, with reference to the pricing policy laid down as governing the operations of a given division.

It has already been said that the forecasts supply the basis of financial control. The forecast, representing the deliberate plan of the corporation as applied to a division, must be based upon an accepted price policy since the factor of sales expectation is necessarily dependent upon the question of price. If the division manager preparing his forecast is in full understanding of the corporation's price policy, he can proceed intelligently. If not, he lacks the prime requisite for formulating his expectation of sales volume. Therefore at the heart of the problem of financial control is the question of price; in fact, the whole is inevitably so interwoven that a comprehensive pricing policy must be an embodiment of a financial policy.

The question of price is one necessarily involving a great variety of considerations. While a specific price as applied to a particular product at a given time may be symbolic, it can never serve sufficiently as an expression of policy. Borrowing a definition of Webster's, there must be a manifestation of the "principles on which any measure or course of action is based, having regard to both the ends aimed at and the measures used to arrive at them". Conditions are changing continually, and there must be a common understanding of the principles embodying the corporation's policy if the organization is to be alive to any need which may arise for reconsideration of price.

To gain a price policy that is comprehensive and understandable *as a policy*, and not misunderstood as a dictation of *specific price*, requires a method founded upon acceptable theory. The following is a description of a method of price analysis that has been found to be adaptable to the situation of General Motors.

It is generally accepted that the lower the price of a useful article the greater will be the demand for it. A new industry, with a product which proves to be of stable character, passes through a development period

characterized by a deficiency in available supply as compared with the latent possibilities of demand. This deficiency results from limitations upon productive and distributive capacity imposed by the adjudged capital hazard, the limitations of personnel experienced in production and distribution, and the time which must elapse before additional facilities can be provided.

So long as there is a deficiency of supply the natural tendency toward an equilibrium between supply and demand will manifest itself by means of price, and the possible scope of demand will not be satisfied until the facilities of production and distribution and the ability of the industry to expand in step with a continued normal growth of demand have reached a state of balance, the point of stabilization.

Profit is, of course, a component of price. During the period of development the excess over the ultimate economic price will be reflected partly in excess costs, because of insufficient knowledge of the art of production and distribution, coupled with scarcity of experienced personnel; and partly in the profit margin, because the final balancing between supply and demand must manifest itself at that point.

Presuming a physical condition under which the supply of a commodity is augmentable, any addition to existing producing or distributing facilities requiring extra capital is dependent upon an attainable profit adjudged to be commensurate with hazard and cost of capital required.

An acceptable theory of pricing must be to gain over a protracted period of time a margin of profit which represents the highest attainable return commensurate with capital turnover and the enjoyment of wholesome expansion, with adequate regard to the economic consequences of fluctuating volume. Thus *the profit margin, translated into its salient characteristic rate of return on capital employed, is the logical yardstick by which to gage the price of a commodity with regard to collateral circumstances affecting supply and demand.*

The considerations which follow are consistent with this theory, and although resting upon a theoretical basis this method of price analysis is wholly practical.

Cost of Capital Fundamental Factor

Supply of a manufactured product is limited on the one hand by the peculiar difficulties in the way of enlarged production and distribution, such as scarcity of raw material or labor, lack of diffused knowledge of the art, restriction by patent rights or secret processes, etc. These limitations will reflect themselves in price of the product through costs or profit (or both) to an extent depending upon the degree of limitation. On the other hand, supply is limited by capital requirement. The method here advocated associates these limitations upon two sides of an equation and recognizes the limitations upon the capital side as fundamental.

If unlimited fresh capital could be had at a fixed interest cost, the pricing theory would be to set the price at that point which would yield the highest attainable volume so long as it be assured that each succeeding increment of volume, resulting from price influence, affords added profits in excess of the interest cost of the added capital requirement. Stated another way, if at a given price and volume the profit margin is such as to yield a high rate of return on the capital employed, and if volume is susceptible of increase by price reduction, then a price reduction is desirable, provided the added volume affords an increase in aggregate profit in excess of the economic cost of the additional capital requirement.

Factors Determining Rate of Return

A monopolistic industry, or an individual business under peculiar circumstances, might maintain high prices and enjoy a limited volume with very high rate of return on capital, indefinitely, at the sacrifice of wholesome expansion. Reduction of price might broaden the scope of demand, and afford an enlargement of volume highly beneficial, even though the rate of return on capital might be lower. The limiting considerations are the economic cost of capital, the ability to increase supply, and the extent to which demand will be stimulated by price reduction.

Thus it is apparent that the object of management is not necessarily the highest attainable *rate of return* on capital, but rather the highest return consistent with attainable volume, care being exercised to assure profit with each increment of volume that will at least equal the economic cost of additional capital required. Therefore the fundamental consideration is the economic cost of capital to the individual business.

As a matter of fact there is never an unlimited supply of capital at a fixed interest cost, and the economic cost of capital embraces the questions of capital position, availability of capital within the business to meet the requirements of added volume, sources of additional capital, and the position of the common stockholders or proprietors as affected by their contribution of an appropriate part of the capital employed, through retention of earnings or otherwise.

In the absence of a governing policy, the pricing of product is likely to be haphazard and inconsistent with the primary considerations. In any event the complexity of the problem is apparent, the elements involved, while not all susceptible of exact analysis, being present in fact. Unless those elements are considered in orderly form they are more than likely to lose their relative significance.

Therefore there is always the need of a basic pricing policy that is sufficiently definite and inclusive to afford effective control, with its constituents sufficiently separable to facilitate continued scrutiny, so that necessity for modification will be detected promptly. As serving these essentials, a sound pricing policy must be founded upon a clear conception of what might be implied in the phrase *economic return attainable upon the capital required.*

The average capital turnover of a manufacturing business, apart from other considerations, varies according to the degree of fluctuation in volume, which condition is intensified by high proportionate fixed investment. Facilities must be maintained to take care of peak volume, and the farther the peak is removed from the average volume the lower the average

productivity of fixed facilities. With equivalent average costs and price of product the average return on capital employed in the case of one plant operating at an average of 85 per cent of capacity will be greater than in the case of an equivalent plant operating at an average of 75 per cent of capacity. Either the capacity of plant must be greater or the average volume less in the latter case, and the productivity of the capital correspondingly less.

In the case of two competing establishments situated respectively as just cited the relative return attainable upon capital will be affected directly by the conditions named. Furthermore, so long as the return is greater than the economic cost of capital, and demand may be increased by price reduction, the rate of return that is desirable to govern the pricing of product is qualified by the question of capital turnover, even where there is no competition or where the rate of capital turnover is common throughout a competitive industry. This is because at a given rate of return on capital the percentage profit margin is indirectly proportionate to the rate of capital turnover, and a wide margin supplies a corresponding latitude for stimulation of demand.

In other words, a reduction of 5 per cent in price might have an equivalent stimulation upon demand, but due to its proportion of the profit margin, the resultant volume might in one case afford added profit in excess of the economic cost of additional capital requirement, while in another case of higher capital turnover the added volume might afford no added profit, or that which is less than the economic cost of the additional capital requirement.

The rate of return attainable upon capital is interlocked with the question of capital turnover, and a measure of the normal average capital turnover is necessary in forming a conception of the economic return attainable.

Pricing Policy Must Consider Average Return

While it is ordinarily recognized that return on investment is the basis of a pricing policy, the usual procedure lacks the complement of a systematic gage as to the suitable variation of return in periods of relatively high or low volume. Capital is not attracted, except for speculative purposes, by a temporary opportunity for return, but by the promise of a suitable ultimate average, coupled with the element of amortization where permanency is not assured. With this attribute recognized, it becomes obviously confusing to treat with the pricing question upon a plane of capital return in specific periods when, by the nature of things, the basis must be changing continually through the influences of fluctuating volume.

The adaptation of the basic pricing policy is much more orderly if it is conceived and laid down as a standard representing the average condition, and so arranging its employment for price-fixing purposes that a suitable variation in return on capital in transitory periods is automatic. Therefore economic return attainable, as used in this article, is the accepted standard which represents expectation on the basis of an ultimate average condition. It should be under continual observation and should be modified to accord with changes in fundamental conditions, but it does not vary by fluctuations in volume of business.

Normal Average Rate of Plant Operation

The normal condition of any business of a stable character affords continued growth in step with the growth and increase of purchasing power of the community served, coupled with the broadening influences upon the scope of consumption arising from lowered prices and enlarged appreciation of the utility of the commodity. Such growth cannot follow a straight line curve, but is interrupted by conditions existing in boom periods and periods of depression. If the trend line could be exactly located it would represent a normal average condition, but quantitatively it is undergoing continual change, and possibly will at no time coincide with actual volume over any considerable period.

On the other hand, a fluctuating volume, at times above and at times below the trend line, may be normal at all times over a series of years, for volume may be said to be normal if it is suitable in view of collateral circumstances. Thus an effort to establish a definite quantity volume as normal would be meaningless except as of a given moment. Still the normal average rate of plant operation is an essential in determining average capital turnover, so it is necessary to establish a factor of some kind that is representative of a normal average condition.

Plant Capacities and Pricing

If for a moment it be conceived possible to determine the average volume trend line of a business projected forward, and to predetermine the degree of fluctuation above and below the average in the course of a business cycle, it would follow that plant capacities would be maintained on the basis of average demand, with an allowable margin to take care of the excess in boom periods. Plants would operate at the point of practical capacity in years of highest volume because the demand in such periods would be recognized as peak requirements not calling for additional capacity margin. Any capacity in excess of the requirements of the highest volume year would admittedly represent unnecessary investment upon which no return could be enjoyed. The truth of the assertion is not destroyed by the fact that conditions surrounding business are not such as to admit the exact premise as a practical matter. Capital invested in plant, if proved unnecessary, is admittedly non-productive. If the condition arise by reason of business uncertainties, and is warranted on the score of prudent management, the non-productive investment assumes the character of normal capital requirement. If it arise from the lack of reasonable analysis and judgment of business conditions it should be eliminated, in effect, from the capital upon which a pricing consideration is based. Any other course lacks justification.

["Pricing Policy in Relation to Financial Control," will be concluded in the March number of MANAGEMENT AND ADMINISTRATION.—The EDITORS.]

Absentism Factors for Industrial Plants

Management Data Summary—Number 23*

By J. D. HACKETT

Consultant on Labor Problems

Index Number
658.31816 Absentism

ABSENTISM is a chronic condition in industry but its nature and extent are often unrealized. Though different in character from other forms of lost time it is often undifferentiated. The term, "absentism" may be described as a temporary cessation of work, for not less than a whole working day, on the initiative of the individual employee whose presence is expected by the employer.

The relation of absence to other forms of time lost is shown by the following explanation of terms:

1. *Lateness:* A failure to start work at the assigned time. It ends where absence begins.
2. *"Leave of absence":* In this case the presence of the worker is not expected since the leave must be granted by someone in authority. It is vacation without pay.
3. *Lockout:* A collective, and sometimes permanent, separation from work, on the initiative of the employer.
4. *Lost time:* A generic name for time lost by absence and lateness.
5. *Overtime:* Lateness is undertime; work performed after the regular time is overtime. Overtime engenders lateness and absence.
6. *Separation:* This is a permanent cessation of work, and the vacancy can be filled without delay.
7. *Shutdown:* A cessation of work by the manufacturer. There is no absence during shutdown according to the foregoing definition.
8. *Strike:* A collective, and sometimes a permanent, separation from work, on the initiative of the worker.
9. *Vacation:* Granted on the initiative of the employer who is thereby enabled to provide a substitute.

Relative Importance of Absence

The relative importance of absence, as compared with other hindrances to production, must be borne in mind when considering the whole subject.

1. *As compared with lateness.* In volume of time lost, lateness is trivial as compared with absence. It was, as 1 to 17.7, as 1 to 12.3, and as 1 to 24.3 in some recently investigated cases. But, "Tardiness, as it indicates the attitude of the employee towards his work, is of greater importance than absence," according to B. J. Mullaney, in an address before the American Management Association, October 1923.

2. *As compared with lay-off.* The need for a lay-off is often deplored but the volume of productive time lost through this cause is often less in the course of a year than that due to the small but persistent daily absence of employees. An employer cannot control the cause of lay-off but he can reduce the amount of absence.

3. *As compared with turnover.* Absence, according to P. S. Florence, "in many cases has been more costly than turnover". Absence increases as turnover increases. "What begins as lateness, continues as absence, and ends in turnover."

4. *In relation to the business cycle.* Absence increases in times of expansion when production is most needed, and decreases in times of depression when an absentee can be easily replaced. Plans for decreasing absence in boom times should be laid in periods of depression.

A large New England firm, operating in January 1923, at 50 per cent capacity had an absentee factor of 2 per cent, whereas in 1919, operating at full capacity, the factor was 8 per cent, according to an *Iron Age* editorial, January 17, 1923.

The Nature of Absence

Absence is a subject confined to factory workers and not to the executive, supervisory or clerical force, the members of which receive payment by check, work overtime without extra remuneration when there is work to be done, and get a vacation with pay as a regular procedure.

Absence is largely preventable. Perhaps 6 per cent is unpreventable though some companies have a persistently lower record, an evidence of good management, as a rule.

A low percentage is not always desirable. In times of depression an employer may want to conserve the volume of work for those who want to work and therefore the amount of absence increases among others.

Some causes of absence are obscure, others are apparent. In the first place workers may be injudiciously selected, improperly placed, or the wages may be too low; hence, they feign sickness and look for another job. Overtime workers may make enough in five days to rest the sixth, or they may be "fed up" and need relaxation. If men are on piece work they are apt to take an occasional day off, making up the loss of the wages by an extra effort later. These underlying causes do not appear on the records since workers

* This article is one of a series which gives in concise, factual form standardized methods and accepted practice generally applicable in industrial operations.

do not care to tell on themselves. Distinction must often be made between a cause and an excuse.

Classification of causes. A simple classification, suitable for the use of most plants, is the following:

Code		Cause of Absence
A	Accidents	In plant
B	Accidents	Outside plant
C	Sickness	Personal
D	Sickness	Children
E	Sickness	Other
F	Death	Family
G	Death	Funeral
H	Personal	Household duties
I	Personal	Religious services
J	Personal	Visits of relatives
L	Personal	Out of town
M	Business	Geueral
N	Legal	Naturalization
O	Legal	Court summons
P	Legal	Witness
Q	Legal	Jury duty
R	Legal	Registration
S	Miscellaneous	Military
T	Miscellaneous	Other

Attempts have been made to classify causes into "controllable" and "uncontrollable" groups, but it has been found difficult to determine the limits of these factors and, therefore, to secure useful or consistent results. A more specific grouping is "with permission" and "without permission" but, permission, depending on the whim or favoritism of the foreman, may act as a detriment to discipline and the plan can be based on no consistent policy since each foreman will have a different view as to what constitutes permissible absence.

Responsibility

The worker is mainly responsible for absence. The employer, however, may be indirectly responsible as, for instance, when there is no control, when the wrong worker has been selected, when the work is too hard, or when working conditions are bad. Lack of medical supervision tends to increase the amount of absence since most absences are due to some form of sickness.

The Calculation of Absence

Absence may be calculated in a variety of ways:

1. Time (days or hours) lost per employee per year.
2. Time lost in relation to time that could have been worked.
3. Time lost in relation to time worked.
4. The modulus of employment.

1. *Time lost per employee per year.* The time lost, expressed in days, is more practicable but less accurate than when expressed in hours. The Hood Rubber Company had an average of 18.26 days lost per employee per year, 1919-1920.[1]

2. *Time lost in relation to time that could have been worked.* Add the time lost to the time worked to get the time that could have been worked; divide the latter into the time lost to get the percentage, the usual way of stating absence.

3. *Time lost in relation to time worked.* This is an incorrect, though sometimes used, method of determining the absence rate.

4. *The modulus of employment.* This is the percentage of full time workers, a method proposed by Professor J. H. Willets and complementary to the time lost in relation to the time that could have been worked.

A typical calculation under the second method is as follows:

1. Total number of days lost per month.....1,642
2. Total numbers of days which might have been worked during the month.
   (Average number of employees at work .....1,133)
   (Number of days worked per month ..... 24)
   (Number of days lost.....1,642)
   1,133 × 24 plus 1,642 equals..... 28,894

$$\frac{\text{Total time lost in days}}{\text{Total possible days of work}} = \frac{1,642}{28,834} = 5.7 \text{ per cent absence.}$$

The rule is, therefore: Divide the total days (or hours) lost by the total number of days (or hours) that could have been worked, in order to obtain the percentage of absence.

Ascertaining the amount of absence. "The date of the beginning of absence is the date on which the employee quit work, irrespective of the hour. The date absence ends is the date prior to the one on which the employee returns to work, irrespective of the hour."[2]

The Extent of Absence

The extent of absence varies with the industry, the season, the plant, the management, factory conditions, and with the individual according to age, sex, marital condition, and nationality.

Figures from individual plants may be accepted, with caution, since there is no established method for determining absence. Unless special steps have been taken, absence will vary from 10 to 17 per cent. In well-organized plants 4 per cent and even lower percentages have been recorded. The Hood Rubber Company has an average of 5.67 per cent of the total working time. The extent of absence in companies which have not compiled statistics may be very considerably higher than the average. Absence is less in large plants than in small, due probably to more organized methods of reduction. Very low figures sometimes result from methods which arbitrarily exclude certain classes of absentees. Table 1 shows some typical results found in different plants.

According to P. S. Florence, absence varies with the nature of the work, being:

In shipyards, 8 to 24 per cent.
In factories where heavy work is done, 6 to 11 per cent.

[1] See *The Nation's Health*, October 1921, "A Study in Industrial Absenteeism," by R. S. Quinby.

[2] See Public Health Reprint No. 484, August 13, 1918, "Industrial Morbidity Statistics."

In factories where work is light, 3 to 8 per cent, average 5½ per cent.

In plants with preventive organization, as low as 1.8 per cent.

TABLE 1. EXTENT OF ABSENCE IN VARIOUS INDUSTRIES

NAME OF COMPANY OR NATURE OF BUSINESS	YEAR	PER CENT OF WORKING TIME LOST
South Carolina cotton mills	1916	11.3
Ford Motor Co	1918	6.4
Car-building plant	1918	10.0
Hood Rubber Co	1919	5.65
Women's garments	1920	10.4
American Pulley Co	1917	7.54
Compton-Knowles Co	1917	8.5
Four textile mills	1920–1922	4.6

Extent of Absence, By Cause

The principal cause of absence, in one form or another, is sickness, as indicated by the figures in Table 2.

TABLE 2. EXTENT OF ABSENCE, BY CAUSE[1]

CAUSE OF ABSENCE		PER CENT OF WORKING TIME LOST	
		PLANT A	PLANT B
Accident	Industrial	0.05	2.52
	Non-industrial	0.10	1.44
Sickness	Personal	49.22	37.06
	Of others	11.58	.....
Personal	Miscellaneous	33.79	58.98

[1] See *The Nation's Health*, October 1921, "A Study of Industrial Absenteeism," by R. S. Quinby.

An investigation made by the New York State Department of Labor, covering July to December, 1919, of absences from work for three days or more disclosed the following:[3]

	Male	*Female*
Total employees covered	57,148	19,411
Total cases of sickness reported	5,777	2,984
Total loss in working days	53,801	30,868
Total loss in wages	$234,591	$87,224
Average number of days lost per employee	0.9	1.6

Since most absences are of short duration the above figures indicate only part of the problem.

Character of sickness causing absences. The U. S. Public Health Report, December 29, 1922, gives figures showing disabilities causing absence from work for one week or more as reported by 22 sick benefit associations in 1921—Frequency of specified disease groups, causing disability for one week or longer, in December 1921; 22 sick benefit associations with 56,511 members:[4]

Diseases	*Number of Cases per Thousand Persons per Year*
All, except the venereal diseases	105.2
General, excluding influenza, grippe and tuberculosis of the lungs	10.1
Nervous system, including organs of the special senses (eyes, ears)	7.1
Circulatory system	6.2
Respiratory, including influenza, grippe, tuberculosis, and diseases of pharynx	45.7
Digestive system, except diseases of pharynx	13.7
All other diseases and conditions	28.6

Departmental absences. Absence varies departmentally. In a manufacturing plant, out of 24 departments one had a loss of 32.22 working days while another had a loss of only 5.78 working days per year per employee.[5] Another plant shows an attendance of 98 per cent in the tool shop and 70 per cent in the sales department.[6] The home office employees of a large Middle West corporation show an absence rate (due to sickness and accident) of 8.12 for all departments, which varied from 10.35 in the stenographic department to 5.21 in the traffic department.[7]

Occupational absence. An interesting comparison of the absence rate for men and women in the same occupation is shown by the figures in Table 3. From Philadelphia textile mills, March to August, 1922.[8]

TABLE 3. OCCUPATIONAL ABSENCES PHILADELPHIA TEXTILE MILLS

OCCUPATIONS	MAN-DAYS LOST			
	Men		Women	
	No.	Per Cent	No.	Per Cent
Beamers	128	1.46	104	2.49
Clerical employees	292	3.71	329	3.89
Coners	75	3.55	1294	8.83
Quillers	88	2.53	268	4.55
Weavers	1185	4.53	1969	8.09
Winders	48	4.54	488	5.21

In a car-building plant the differences in Table 4 are shown:

Absence and the Individual

Women have a higher rate of absence than men in the same occupation. (See Table 3.) Even in different occupations (women's work being lighter as a rule) the rate of days lost, due to sickness and absence per year, in one instance was 8.73 as compared with 5.0 for men.

The rate of absence increases with age from 20

[3] See Special Bull. No. 108 N. Y. State Department of Labor, "Sickness Among New York State Factory Workers in 1919."

[4] See Public Health Report, Vol. 37, No. 52, p. 3196, "Morbidity Among a Group of Wage-Earners."

[5] See Public Health Report No. 37, September 1920, p. 2148, "Sickness and Absenteeism During 1919 in a Large Industrial Establishment."

[6] See *Factory*, July 15, 1920, p. 214, "A Plan That Improved Attendance 200 Per Cent," by W. S. Dutton.

[7] See Public Health Report, No. 10, Vol. 37, March 10, 1922, p. 531, "Sickness Among Office Employees."

[8] See Supplement to Annals of the American Academy of Political and Social Science, No. 103, November 1922, "Attendance in Four Textile Mills in Philadelphia."

TABLE 4. OCCUPATIONAL ABSENCES CAR-BUILDING PLANTS[1]

Occupations	Average on Pay-Roll	Absence	
		No.	Per Cent
Bookkeepers	243	14	5.8
Car-body builders	1,021	150	14.7
Inside car finishers	305	44	14.4
Laborers	1,250	110	8.8
Machinists	505	39	7.7
Painters	580	63	10.9
Punchpress operators, etc	498	52	10.4

[1] See *Journal of Political Economy*, June 1921, p. 167, "Labor Absenteeism," by E. Frankel.

years upwards for both men and women, but the increase is more rapid for women than for men. There is a very decided increase in absence in the age group 55-64, the rate of the age group, 45-54, being about half.[9]

Physical disability, as determined by physical examination, increases the rate of absence, according to the figures in Table 5:

TABLE 5. EFFECT OF PHYSICAL DISABILITY ON ABSENCE[1]

Physical Examination Classification	Days Lost per Employee on Account of							
	Sickness		Accident				Total	
			Industrial		Non-Industrial			
	Male	Female	Male	Female	Male	Female	Male	Female
Class 1	4.25	7.07	0.25	0.09	0.16	0.21	4.67	7.37
Class 2	4.51	10.31	0.59	0.11	0.16	0.30	5.27	10.72
Class 3	5.59	11.12	0.44	0.80	0.21	0.00	6.23	11.92

[1] See *The Nation's Health*, October 1921, p. 575, "A Study of Industrial Absenteeism," by R. S. Quinby.

Absence and Wages

The wage rate affects absence for several reasons. Low wages mean a low standard of living, which affects health and thereby causes absence. Moreover, low paid workers lose time in looking for better paid jobs. High wages, on the other hand, prompt men to take occasional days off. In seven cotton mill villages, studied in 1916 [10] the following conclusions were reached:

> A higher sickness rate (involving inability to work) and a greater amount of working time lost on account of such sickness were found among members of families whose incomes were low than among members of families with a more favorable economic status.

Absences of brief duration are largely in the majority. Example 1 in Table 6 is a New York felt, silk hat, and millinery establishment employing 750 workers of whom half were women showing absences due to sickness in 1920.[11] No. 2 gives figures for males and females from four textile mills in Philadelphia.[12]

TABLE 6. COMPARATIVE DURATIONS OF ABSENCES IN TWO PLANTS

Duration of Absence	Absences					
	Plant No. 1		Plant No. 2			
			Men		Women	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
1 day	365	58.12	1009	65.0	1498	65.7
2 days	76	12.10	216	13.9	287	12.6
3 days	79	12.58	97	6.3	139	6.1
4 days	29	4.62	78	5.5	106	4.6
5 days	18	2.85	44	2.8	72	3.2
6 days	11	1.76	33	2.1	46	2.0
7 days	9	1.43	9	0.5	18	0.8
8 days	4	0.64	8	0.5	12	0.5
9 days	5	0.80	10	0.6	10	0.4
10 days	4	0.64	7	0.4	13	0.6
11 days	2	0.32	10	0.6	13	0.6
12 days	2	0.32	6	0.4	12	0.5
13 days and over	24	3.82	21	1.4	52	2.4

The figures in the table indicate that the number of absences of three days' duration and less form about 80 per cent of the whole, but that the total actual time lost in the short-time absences is about 40 per cent. It is clear, therefore, that any method of prevention must concentrate on the elimination of these short-time absences.

Information as to the length of employment of absentees, the number of absences of each individual per year, and the number with a record free of absences is as yet fragmentary.

Absence shows a persistent tendency to be greater on Monday than on any other day of the week, Saturday, in some cases, being the second highest. Absence tends to be lower on pay-day than on other days and relatively higher the following day. But, in the larger plants, where pay-day comes according to date, attendance increases from Monday to Friday.

There is a tendency to higher rates of absence on night, than on day, work with occasional exceptions due, perhaps, to higher pay and the ability of attending to outside business during the day time by night workers.

Seasonal absence. There is less absence in the spring and fall than in the winter and summer months, affected respectively by weather and vacations. The figures in Table 7 indicate seasonal variations.

The Prevention of Absence

The three principal steps in prevention are:

1. Centralization of preventive measures.
2. Determination of character and extent of absence.
3. Establishment of method for dealing with problem.

[9] See *The Nation's Health*, October 1921, p. 573, "A Study of Industrial Absenteeism," by R. S. Quinby.

[10] See U. S. Public Health Report, Reprint No. 492, "Disabling Sickness Among the Population of Seven Cotton-Mill Villages of South Carolina."

[11] See *The Nation's Health*, July 1921, p. 414 (adapted), "Health Work in Five Industrial Plants," by A. E. Shipley.

[12] See "Attendance in Four Textile Mills in Philadelphia," p. 212 (adapted).

TABLE 7. VARIATIONS OF ABSENCES BY SEASONS OF THE YEAR[1]

QUARTER	MAN-DAYS WORKED	MAN-DAYS LOST	PER CENT ABSENCE
January-March	291,004	15,518	5.06
April-June	359,721	17,045	4.52
July-September	290,220	14,781	4.84
October-December	215,739	8,504	3.79
	1,156,684	55,848	4.66

[1] See "Attendance in Four Textile Mills," p. 200 (adapted).

Establishment of Absentee Department. A separate section, under the employment department, may be established. This section designs the forms to be used, standardizes the method of procedure, secures statistics from all departments, and disseminates the results.

Determination of the fact of absence:

1. Direct report from absentee by telephone or by card.
2. Report from foreman who may know of cause.
3. Report from fellow worker living in vicinity of absentee.

Investigation of cause. If there is no report an investigator is sent out to ascertain the cause. Investigation is one of the best preventives. It should be immediate, since most absences are of short duration. If there is no investigator the absentee should be interviewed on return both to ascertain the cause and to stimulate future regularity.

Education of the worker. The worker may be induced to regularity of attendance by ordinary methods of advertising such as pamphlets, cartoons, and bulletins. Statistics may be published in the plant periodical showing attendance by department on a percentage basis. Good attendance should be considered as a factor in wage increase or promotion and the worker should be aware of the fact.

Competition. In some industries an appeal is made to the spirit of rivalry existing between different departments:

> Our plan aims to develop a competitive spirit of rivalry between departments by the use of monthly reports. Each month department heads receive a report showing the rating of all departments. This is posted on the bulletin boards for inspection of the employees.[13]

Removal of the cause. Various plans are used to remove the occasion of absence. Efforts are made, for instance, to select workers who live within a moderate distance of the plant. The Industrial Service Department of the White Motor Company receives money from its employees and pays their telephone, gas, and electric bills in order to eliminate this cause of absence.

[13] See American Management Association Convention Report, October 1923, "Absenteeism and Tardiness," by Bernard J. Mullaney.

Health maintenance. Since about half all absences are due to sickness it is apparent that a medical department helps to prevent as well as to reduce absence; prevention is accomplished by health education, mitigation by medical attendance. In some cases the nurse investigates all cases of absence on the presumption that sickness is the cause, while the doctor makes physical examinations of each returning absentee. Incidentally this practice tends to reduce the number of fictitious sicknesses. A competent analysis of causes indicates to the physician what medical remedies are necessary in cases of illness.

Remedies for Absence

Rewards and penalties. Rewards for good attendance may be offered in a great variety of forms, some of which follow:

1. *Money.* This usually takes the form of a percentage of wages for "perfect attendance" over a predetermined period. The rate is usually a dollar a week, or from 5 to 10 per cent of wages. The amount is commuted according to the number of absences or latenesses. "Perfect attendance" is freedom from any lost time within a specified period. This plan obviates the need of an investigator since no excuses of any sort are accepted. Payment of money for regular attendance is wrong in principle but in boom times the attendance bonus has been found useful. One dollar a week is said to have reduced absence as much as 66 per cent.

2. *Honorary rewards.* One plan takes the form of a different colored button worn at work; red for 30, blue for 60, and white for 90 days of perfect attendance. Sometimes a "perfect attendance" certificate is issued.

3. *Competition.* A spirit of rivalry is induced by the display of good attendance records and by the presentation of a banner to the team winning these special contests.

4. *Vacations.* In some places vacations are given to women on repetitive work for perfect attendance. The practice is to give one day off with pay for an employee who loses no time, or to add an additional day's pay in lieu of the holiday. Perfect attendance for a year entitles the employee to a week's vacation with pay.

5. *Penalties.* Practically all well-managed plants have abandoned docking and fines as a means of inducing attendance. Fines, as a rule, are useless, vexatious, ineffective, and sometimes illegal. In some plants the employee with the worst record has his name placed on the bulletin board for all to see. Persistence in lateness results in discharge and care is taken to publish the fact.

In conclusion, attention is called to the fact that according to the last census the capital investment per employee in the United States is about $3,000, and it is increasing every year. Idle machines cost heavily in money lost, since interest on the investment and profit from the product are both sacrificed. Thus, there is every reason to endeavor to reduce the volume of industrial absences, which may appear to be few, but in reality are many.

Preparing Employees to Keep Jobs in Old Age

By E. H. FISH

Index Number
658.3 Personnel

WITHIN the memory of some readers there was a time when thrift included provision for old age. Now we expect that the firm we work for will see that we are provided with money enough to keep us out of the poor house, through pension funds of every kind imaginable. But how about the poor workman who has not really grown old but who has lost his speed, whose eyes have begun to go back on him, whose feet give him trouble, whose back aches with little provocation, the man who has worn himself out in faithful service and is yet far from being an old man?

Anything the employer can do for this man is necessarily paternalistic. It implies the invasion of the workman's private affairs. Suppose we say to a laborer at the age of twenty, "We are going to take out of your pay envelope a certain small amount every week, and when you begin to slow down we will give it back to you by maintaining your pay at more than you earn." Two things would be sure to happen. First, the man would be suspicious and would question whether he wanted to work for us at all; second, if he did stay he would figure up every week how much he had taken out of his pay, and when that amount became enough to make a first payment on a car, or a radio, or whatever he wanted most, he would leave our employ and take his money with him. The only persons with whom it is likely to work, are those whose intelligence is too low for them to figure it out, and those whose intelligence is too high for them to need any such help.

Mental and Muscular Work

The larger the proportion of mental work involved, the less is the let-down in earning capacity with increasing age. A great many laboring jobs, and many that combine brain and hard work have been abolished by labor-saving machinery, or have become so much altered that the laboring part is of less importance. But, no matter how many jobs are thus changed about, there will always be pioneer jobs, the special work that is not developed to the extent that hoisting machinery or other handling machinery can be used to advantage. It is likely that there will always remain this minimum of work for which muscle will be the greatest asset to the worker.

It seems, however, as though there ought to be some attention to this matter on the part of employers. They have an interest as well as the workman himself. One shop may not hire a given man more than a few months; they may think that they do not care what becomes of him after he leaves, but someone has to employ the broken downs of industry. They do not go on the scrap heap, but they do find jobs in some way or other. Why not make use of their knowledge and experience as they grow older and stiffer in the joints?

Comparatively few shops have any distinct paths of progress marked out. Workmen themselves cannot tell whether they are being promoted or demoted except by the pay envelope. Suppose that a superintendent should say, "At thirty years of age any laborer who is not willing to take a less strenuous job will have to hunt another place to work." Or suppose he should say to his employment manager, "It is your job to see that these husky boys are put in the way of learning some less manual kind of work by the time they are thirty, or forty," or whatever age may seem reasonable.

Such action will meet opposition from the large class of men, and women, too, that hate to think more than they hate manual labor. As things go at the present time, however, workmen complain of the lack of opportunity to get ahead. Of course they are wrong, the opportunity is there, and it is looking for them, but neither they nor the opportunities are looking toward each other much of the time.

The Study of Men

The real solution of the problem lies in the study of men. Some of us thought five or six years ago that the employment manager was going to be the man to do it, but experience developed the fact that the employment manager in a shop of 5000 men is as far from the individual workman as the boss himself.

The foremen are really the men to collect this personal information. They can be provided with card forms on which to record age, height, weight, education and all that, but what they should know is less of a material nature, and not so easily rated on a card. For example, it is necessary to know what, if anything, is keeping the minds of men off of their work, that being the greatest source of loss in production. Among some of the younger men, the answer will be "sports or entertainments," a certain amount of which everyone should be able to indulge in without interference with his work. As men get older, this changes to "children," to "debts," and so on. If it is known that a man worries, and what is the source of the worry and its cure, the man is a friend of the shop for life, and he is likely to be a much better worker than before. Of course there are some sources of worry that cannot be removed, but even then, the man who is worrying about family affairs likes to pour his trouble into a sympathetic ear.

The very best cure for all these worries is work and plenty of it. The foreman who can get his men to see that drowning their sorrows in work is much better than merely soaking them in alcohol has made one great step forward. From that it is only one step more to showing these same men that they cannot expect to make their muscles alone pay their way all through life, that they must learn to use their heads, even though it is a real effort to do so.

Applying the Budget to Industrial Operations

"Control Through Organization and Budgets"—Article Three*

By THOMAS B. FORDHAM and EDWARD H. TINGLEY

Superintendent, Delco-Light Co. *Engineer, Delco-Light Co.*

Index Number
658.14 Financial control
658.16 Organization

THE use of a balance sheet is the one really satisfactory way to control a business. This balance sheet need not be made up of actual figures, but it should portray both past conditions and an estimate of the future. The estimate naturally will not be exact, but it can be close enough to the truth to give the general trend of the business.

The balance sheet will be in the nature of a combination of actual and estimated figures and will be mostly used as a business forecast. Such a forecast should take into account both internal and external conditions that may affect the balance sheet.

Information regarding internal conditions is drawn from the budgets prepared for the various divisions and shows what the probable performance of the factory will be for a certain time in the future. A budget is composed, in part, of allowances for expense items, material and labor assigned the various departments. This portion of the balance sheet can be controlled to a large extent.

Factors Affecting the Forecast

The external business conditions which are beyond the control of the individual institution are made up of important market changes and fluctuations in prices of basic materials such as copper, steel or cotton, which vary with supply and demand. These fundamentals cannot be ignored but must be taken into account in making up the forecast, for otherwise the estimated balance sheet will not be reliable. The customary practice in many concerns using the balance sheet and budget is to forecast the future in periods of 30 days, or the calendar month. This length of forecast will usually be long enough to cover the production period and to allow the accounting records to be closed at the end of such a period. Usually the budget is made in detail for the coming month, but a forecast is included covering several months or the balance of the year in advance. This short period of 30 days very often protects the business from unwise decisions or changing market conditions affecting the profit and loss statement to any great extent. Some large corporations make weekly balance sheets as an added precaution.

The logical person to gather the budget estimates and make a business forecast is the comptroller or the treasurer. In a small business these two functions may be performed by the same person. As stated in the previous article, the writers' definition of a comptroller is that person who studies and analyzes conditions within and without the business and compiles, from such records and reports as are kept on file, information of value in determining operating policies. He does not actually control in a managerial capacity any of the work done in any division. He is the student of conditions and results under plans determined by the executives. His work is to bring out the facts hidden in a collection of detailed figures and to find out from reports the trend of the entire business and that of specific divisions and departments. He presents to the management a barometer reflecting the probable future as portended by the policies of the company and the business expectations. He must also be a thermometer indicating the actual present conditions from month to month. He is a combination of business prophet and historian.

Considered from another angle, the comptroller:

1. Lays out the policy of the management in the form of budgets, projecting these policies into the future and showing the expectations of all phases of the business, including the sales of the product and the income from sales, expenses of all sorts, and the resultant expected profit.
2. Interprets the policies of the management to all division heads in terms of dollars as the projected policies will affect them in their divisions.
3. Checks up the actual income and expense against the budgeted income and expense with each division head and the management. This serves as a spur to reach the predetermined objectives of the management.
4. Makes up a monthly balance sheet or profit and loss statement for the management giving the facts of the business as operated the previous month.

Each division of the organization sends to the comptroller its budget figures not later than the twentieth of the month previous to the month for which the budget is to apply. These budgets are summarized and analyzed and the various items placed under different headings on the summary sheet as in Table 8. Column 1 shows the amount of expense which will be a direct charge to the operating statement, column 2 the cash requirements, column 3, the amount of liability incurred *this* month which will be a cash requirement for *next* month, and column 4 items of expense which are occasioned by withdrawals from stock already purchased and book entries, as spoiled work, etc.

In explaining the method of analysis used by the

* See MANAGEMENT AND ADMINISTRATION, December 1923, p. 719, and January 1924, p. 57, for previous instalments.

comptroller, the budget of the manufacturing division will be used as an illustration.[2] The proposed expenditures, while being a direct charge to the operating statement, will necessitate either cash outlays or the incurring of liabilities to be paid for next month. Salaries, traveling expenses, and wages will be cash requirements. (See Table 8). Supplies may be partly withdrawals from stock, and the balance to be purchased during the month will be a liability. Spoiled work is a book entry in column 4 of Table 8. Purchased productive materials will be liabilities, though part may be cash.

The budget of purchases to be made is then analyzed and classified, as shown, into cash requirements and liability incurred; productive labor into cash requirement, and fixed charges into the total expense column. Then by adding these classifications as shown in Table 8, the total factory expenses, the total cash required for the factory for the month, and the liability incurred, which will be a cash requirement for the following month, are determined.

Similarly, the reports from all the other divisions are analyzed and classified. The selling and administrative division budget is shown in Table 9. From the budgets of the individual divisions a summary of operations is made up, as in Table 10, which gives the total expense, cash requirements, liabilities, etc., for the entire business. The total pay-roll is calculated, which is valuable information for the treasurer and paymaster. The total number of employees estimated for the budget month is compiled by the comptroller as in Table 11, and a copy sent to the employment manager who uses it in determining the number of new employees to be hired that month. Let us assume that it is September and the October budget is being compiled. The condensed estimate of cash requirements is formed by adding the liability incurred in September to the cash requirements as estimated for October. To apply against this estimated cash requirement the accounts receivable department reports to the comptroller the estimated cash receipts that are expected during October. To this can be added the estimated available cash in the bank as of October first, and the total when compared with the cash requirements will show the treasurer what additional cash, if any, will be required for the operation of the business for that month. In addition an advance estimate of the cash required for November is made by studying the advance estimates made on the budgets of each of the divisions, and from the liability column total indicated on the October summary of operations, as in Table 10. From the treasurer's viewpoint, an important object of operating under a

TABLE 8. BUDGET OF OPERATIONS
Manufacturing Division, October, 1923

Department	Col. 1 Total Expenses	Col. 2 Cash Requirements	Col. 3 Liability Incurred	Col. 4 Requisitions From Stock and Other Charges
Superintendent's office	$1,350	$1,350		
Plant section	21,775	16,975	$2,750	$2,050
Material section	12,135	10,975	760	400
Labor section	2,765	2,715		50
Equipment section	21,700	16,900	3,200	1,600
Productive section	19,075	8,925	2,000	8,150[1]
Total	$78,800	$57,840	$8,710	$12,250
Productive materials		30,000	64,820	
Freight on productive materials		6,500		
Material to be released on bona fide contracts		16,652		
Resale material			215,000	
Productive labor		53,500		
Fixed charges (depreciation, taxes, etc.)	40,000			
Total	$118,800	$164,492	$288,530	$12,250

[1]Includes $6000 spoiled work.

The above provides for a pay-roll of $53,500 for productive labor and $53,025 for non-productive labor, total $106,525. This figure includes a net addition to the pay-roll of 57 productive workers and 40 non-productive workers classified as follows:

Division	Maximum in September	Maximum in October
Superintendent's office	3	3
Labor section	20	25
Material section	79	91
Productive section	585	655
Equipment section	83	84
Plant section	68	77
Total	838	935

[2] See MANAGEMENT AND ADMINISTRATION, January 1924, p. 60. Tables 2 and 3.

TABLE 9. BUDGET OF OPERATIONS
Selling and Administrative Divisions. October, 1923

Department	Total Expense	Cash Requirements	Liability Incurred	Requisitions From Stock and Other Charges
Sales—domestic	$21,900	$15,300	$6,203	$397
Sales—foreign	12,895	12,120	750	25
Order	2,547	1,960	300	287
Advertising	28,896	21,213	7,521	162
Service parts expense	6,687	5,695	1,127	135 (credit)
Service parts material			8,965	
Administrative	20,900	14,400	2,900	3,600
Renewal commercial paper and bank loans and interest		18,000		
Long-term notes		47,197		
Commissions		40,000		
Insurance		4,000		
Interest charges	15,000			
Capital stock tax		8,420		
Contingency		10,000		
Total	$108,825	$198,305	$27,766	$4,606

The above provides for a pay-roll of $26,795. The number of employees for the above departments is estimated as follows:

	September Maximum	October Maximum
Sales—domestic	27	27
Sales—foreign	7	8
Order	7	8
Advertising	9	8
Office supply stock	7	7
Service		
Office 18		
Repairs 25		
School 1		
Stock 4		
Total	48	48
General Manager	3	3
Patent	3	3
Finance division	38	39
Total	149	151

TABLE 10. BUDGET OF OPERATIONS
Summary, October, 1923

DEPARTMENT	TOTAL EXPENSES	CASH REQUIREMENTS	LIABILITY INCURRED	REQUISITIONS FROM STOCK AND OTHER CHARGES
Manufacturing division	$118,800	$164,492	$288,530	$12,250
Indirect factory departments	21,335	18,035	2,000	1,550
Selling and administrative	108,825	198,305	18,801	4,336
Total	$248,960	$380,832	$309,331	$18,136

The total pay-roll for October should be approximately as follows:

Manufacturing division	935 employees	$106,525
Indirect factory division	100 employees	16,810
Selling and administrative	151 employees	26,795
Total	1186	$150,130

Pay-roll for September approximately—$140,000.

Condensed Estimate of October Cash Requirements

Cash, as per above budget	$380,832
Liability incurred in September payable October	190,221
	$571,053

To apply against this estimate of requirements:

Estimated bank balance September 30, exclusive of advanced sale of commercial paper	$700,000
Estimated bank receipts for October	500,000
	1,200,000
October cash requirements	571,053
Estimated bank balance, October 31	$628,947

Advance Estimate of November Cash Requirements

Cash requirements estimated	$400,000
Liability incurred in October payable in November ($309,331)	310,000
	$710,000

budget system is accomplished, that of anticipating cash requirements for two months in advance.

To the general manager, the operating statement, showing the estimated net profit, is the important outcome of compiling the budget figures, for from the profit there shown he can change plans made or arrange to add emphasis to the sales program so that increased profits may result. The operating statement is compiled as shown in Table 12. The estimate of sales for the coming month is secured from the order department of the sales division and it gives the kind and number of products to be shipped. By converting this into money and figuring the cost of sales for these products, the estimated gross profit is calculated. When the estimated expenses for each division of the business have been subtracted, the result will show the estimated net profit. In the expenses must be included the loss, if any, incurred by the manufacturing division when it does not absorb its total burden or overhead in the amount of the finished product to be made during the month, and put in the warehouse. If production is high enough there may be, on the other hand, an overabsorption of the expense, which will appear as a credit on the operating statement.

To enable the comptroller to fulfil his responsibilities of checking the facts of the business, various reports and records must be compiled and sent to his office. Daily reports of the customers' orders received and the shipments made are compared to the quota of sales set for the sales division and a check-up is thus made on the activities of the sales force. Seasonal variations in sales are recorded from previous years' records and compared to the present.

The daily production of the factory is checked up against the schedule set for that month and an idea gained whether the factory is behind schedule, and thus holding up the shipment of the sales orders or not. From the invoices for purchased materials, the changes in price of materials can be noted and the effect estimated in its result on the cost of the product for the coming few months. Pay-rolls and labor expenses are reported in various forms to show the amounts of money expended in wages. From this and similar data, the comptroller is kept in intimate touch with the internal operations of each division of the business and assists the management in foreseeing and forestalling losses and trouble.

An essential feature of the comptroller's work lies in the use made by the manufacturing division of the

TABLE 11. TOTAL NUMBER OF EMPLOYEES ESTIMATED FOR OCTOBER, 1923

DEPARTMENT	ADDITIONAL	MAXIMUM NUMBER
Manufacturing Division:		
Superintendent's office	0	3
Labor (includes timekeeping, welfare, employment, first aid)	5	25
Material (includes purchasing, receiving, packing, shipping, traffic, shop order, stock records, raw, finished and factory supply stockrooms, truckers, garage and scrap)	12	91
Productive	57	655
Plant (includes electricians, plumbers, millwrights, carpenters, heat engineers, janitors, guards, fire inspector and laundry)	9	77
Equipment (includes plant layout, estimated cost, routing, standard time, betterment, order and record, tool design, tool-making, tool stores, machine repair and pattern departments)	1	84
Indirect Factory Departments:		
Engineering and experimental	0	32
Inspection (includes tool, material, final and test inspection departments)	9	68
Selling and Administrative:		
Sales—domestic	0	27
Sales—foreign	1	8
Order	1	8
Advertising	0	8
Office supply stock	0	7
Service	0	48
General manager	0	3
Patent	0	3
Treasurer (includes cost, paymaster, accounts receivable and payable, etc.)	1	39
Total	96	1186

TABLE 12. ESTIMATED OPERATIONS, OCTOBER, 1923

Product sales { 40—Product A; 920—Product B; 370—Product C; 250—Product D; 70—Product E; 200—Product F; 150—Product G; 150—Product H }			$	
Resale materials				
Service sales				
Sundry				
Total net sales				
Less cost of sales				
Gross profit				$
Manufacturing division expenses	$			
Indirect factory departments	$			
		$		
Less overhead absorbed by production	$			
Less overhead deferred	$			
		$		
Overhead unabsorbed (or overabsorbed)			$	
Selling and administrative expenses			$	
Total expenses to be deducted from estimated gross profit				$
Estimated net profit for October				$

compiled estimated cost of the product as manufactured. These estimates are always made to follow the production methods and systems of wage payment used in the factory. They are not made on an ideal basis but indicate a cost that is possible in the factory with the equipment available. The cost department gathers actual costs from the time tickets of the labor employed, from invoices for material purchased, and from factory expenses that must be charged against the product. These actual costs are compiled in a manner similar to the estimated costs, and are then analyzed by the cost department to discover discrepancies between the two. The gathering of the actual costs is so arranged as to provide cost data not more than two months old at the time of compilation. This can be done fairly accurately if common sense rather than a radical theory of accounting is used as a basis. No cost system can be accurate in any sense if results do not check out with the expenditures recorded in the books of account.

In analyzing the estimated and actual costs, the head of the manufacturing division can be shown where his division is not operating as efficiently as expected when the estimated costs were made up. The labor cost may be too high, the materials costing more than expected, the spoiled work running too high, and so on. These conditions directly affect the percentage of profit made.

The comptroller has another check which can be applied on the manufacturing division budget and that is the use of the estimated costs of the various products as broken down into material, labor, and overhead. By converting the next month's production schedule into material, labor, and overhead, he can readily determine how much the budget for material and labor exceeds that which should be necessary according to the estimated cost. It is very probable that at times the actual production will exceed the comptroller's calculations due to the fact that it may be economical to produce parts in lots large enough to cover several months' requirements instead of just one. However, if there is continually an excess it is evident that the inventory total will be increased, and naturally the comptroller will take steps to halt this overproduction so that the inventory may be kept as low as possible. A small inventory means more turnovers per year with consequent increase in profits.

Analysis of Products

As a further means of intelligent control, it is necessary fully to comprehend the various capacities of the buildings and equipment and the total number of employees necessary to produce such an output. To do this a very careful analysis must be made of all the types of product manufactured, studying the amounts of the component parts that can be made with the machinery and equipment at present in the various departments. This detailed study goes down into the routings and production operations, and includes calculations of machine loads on the various machines in the different departments.

While the equipment supervisor is studying the capacity of the equipment, the productive supervisor is calculating the number of employees necessary to man the equipment and operate the machinery of the various schedules. These figures are compiled by departments and also separated into male and female labor. The other sections of the manufacturing division requiring indirect labor also calculate what labor they will need to operate on the various schedules.

Estimates of Sales Demand

If the factory makes more than one product, several different combinations of products can be assumed for the schedules, which necessitates that the number of employees required for each be kept distinct. Estimates that cover practically every combination of sales demand can be built up in this fashion, and they are invaluable to every superintendent and comptroller who aims to know the real facts about the manufacturing end of the business.

From such schedules and lists of employees it is possible for the comptroller and superintendent to calculate the pay-roll, the material costs, and the operating expenses for the future, selecting whatever schedule they believe the factory will be operating under. It is also possible to foresee the need of further equipment in certain departments, should the future of the business develop along certain lines. In addition the comptroller has the facts from which to check up the factory performance as each month's budget figures are submitted to him.

After the close of the budget period, when the actual figures of the business have been compiled, they should be given to the heads of divisions and set up alongside the estimated figures which have been submitted by them. In this way the items which are above or below the estimate are readily discernible and explanations can be requested where the difference is at all marked. Often sources of losses are uncovered when these discrepancies are investigated. Accuracy in estimating is also gained by checking up these differences so that in time a budget should be correct to within a few per cent. Accuracy, however, cannot be obtained unless all divisions make every effort to keep within their allotted amounts.

Some will doubt the ability of the budget system to work when the important result to be obtained—profits—hinges directly upon the most uncertain of facts, the amount of sales. The system of budget control discussed in these articles is based fundamentally upon the disposal of the product—the amount of sales determining how much work the factory will produce during the coming budget period and what expense will be entailed to replace the product sold. When the sales division gives in its estimate of the sales for the future period, the figures are based on a careful study and on keen analysis of the possible future market. Naturally the sales division must not overestimate the market and must make every effort to sell what it has estimated. The history of many a successful business shows that sales can be made when backed up by a determination to win, and quotas can be met when the right spirit pervades the selling force. The sales organization must realize the purpose of the budget and co-operate to make it a success.

Savings from Conveyor and Molding Equipment

How Foundry Management Has Cut Cost and Increased Output

By ROBERT T. KENT

Mechanical Engineer

Index Number

658.281: 621.72 Mechanical handling in the foundry

THE use of mechanical methods for the moving of the materials of production and of the finished product in any phase of productive industry has invariably resulted in a lower cost of production and increased output for the same amount of productive equipment. The foundry is no exception to this rule. Mechanical handling equipment may be adopted in the foundry to a much greater extent than it is at present, with a consequent saving in labor and other operating costs that is entirely disproportionate to the expense of installing and operating such equipment.

The above statement is not to be taken as a plea for more or better crane facilities. Most foundries are, as a rule, well supplied with these. It is rather the statement of a proposition that the efficiency of foundry operations can be improved by the same methods that have effected the same improvement in other industries. These methods include the substitution of machinery for man-power and the elimination of idle time of productive equipment and of productive workers. In the foundry this can be done by supplementing the established crane facilities with specially-designed machines for handling materials, whose purpose is to make possible the maximum utilization of the foundry equipment proper.

The Ideal Efficiency

In the foundry, as in every other industry, the lowest operating costs, the highest return on the investment, and the maximum percentage of profit are secured when the productive machinery is operated 100 per cent of the working hours, and when each worker in the establishment works for the longest possible time at the job for which he is best fitted, and at which he can give the largest return for the wages paid to him. In no industry are the above principles more consistently violated than in the foundry as commonly run. The productive equipment is used during a low percentage of the working hours, and frequently high-priced, skilled labor is utilized for work that could be as well or better done by a lower and cheaper grade of help or by machinery. It follows, therefore, that any method or any machinery that will enable the foundry to approach more closely the ideal stated above will put it on a more efficient and profitable basis. The wider use of mechanical handling equipment will do this, although it may be necessary for some foundrymen to revise their ideas concerning the operation of foundries.

In order to establish a basis of comparison for the advantages of mechanical methods, it will be necessary to consider the operation of a foundry according to the methods in common use, and then to ascertain wherein it might be improved by the addition of special machinery. Let us take for an example a small foundry, manufacturing small or medium weight castings. Whether the molds are made by hand at the bench or on molding machines is immaterial, except that the molding machine will increase the productivity of the individual molder, and thereby is a step in the right direction.

In the usual course of operations the molders spend the entire morning and the first part of the afternoon in making molds. In the case of machine or bench molders, the molds are carried to the pouring floor, a varying distance from the place where they are made, usually by the molder but sometimes by a helper. When the molds are carried by the molder, the time used in so doing is time lost from the productive work for which

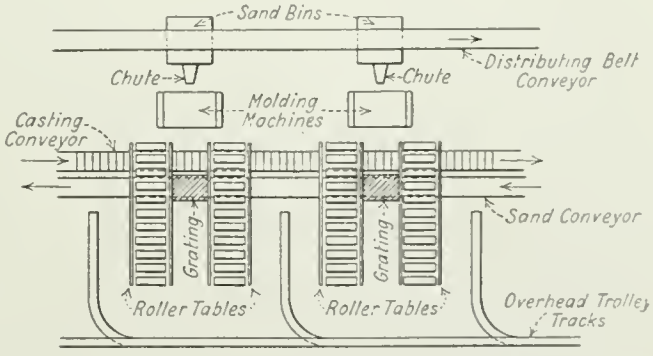

FIG. 1 ARRANGEMENT OF CONVEYORS FOR INCREASING FOUNDRY OUTPUT

the molder is paid. In the case of machine molding, this time represents a serious item of loss, for although the time for each mold may be small, say an average of one-half minute per mold, the total for a daily output of, say, 100 molds, is close to an hour. This represents an unnecessary loss of production equal to the output of the machine for one hour. Furthermore, this work which could have been done better by a laborer or by a machine, has been paid for at the rates of highly skilled labor.

About the middle of the afternoon the molds are poured. The molders are frequently used for this operation, carrying the hot metal from the cupola or other melting furnace to the molds, or from bull ladles which bring it to a more convenient point. Meanwhile, molding has stopped, and the molding equipment remains idle for the rest of the day.

After pouring is completed, the molders break open the molds and pull the castings from the sand to cool. The cooled castings are usually gathered up and the

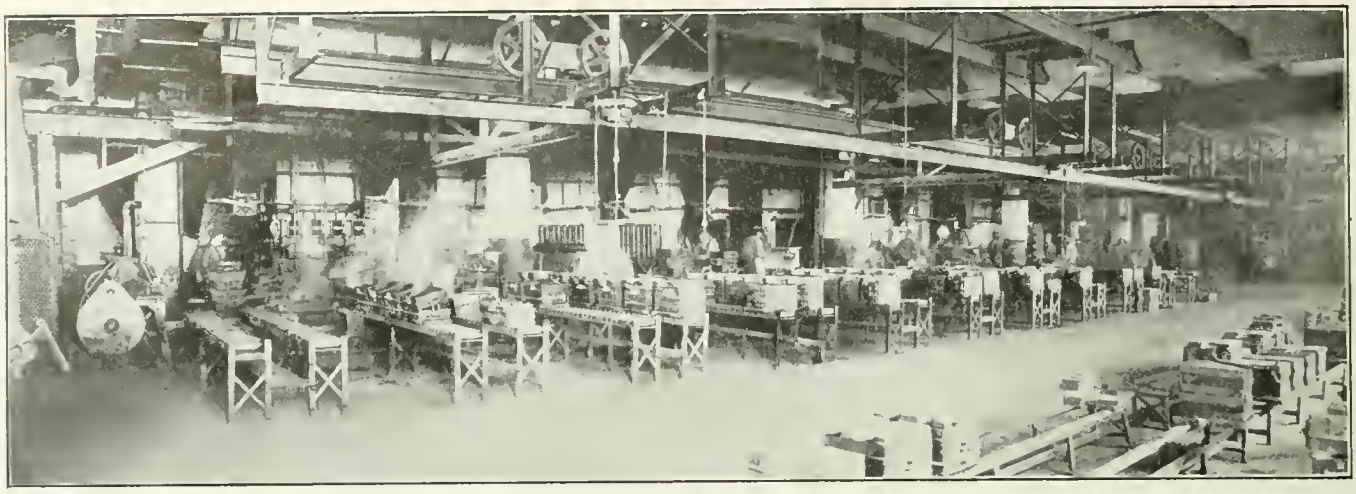

FIG. 2 INTERIOR OF FOUNDRY OF STROMBERG MOTOR DEVICES CO., CHICAGO

sand cut over and tempered for the following day by a laboring gang on the night shift.

Let us next examine an arrangement that will avoid most of the faults of foundry operation that were noted above. Fig. 1 is a diagrammatic arrangement of equipment that will permit of the continuous operation of both molding and melting. A sand bin overhead, to which sand is delivered by a belt-conveyor, furnishes sand to the molding machine. Immediately behind the molder are two or more roller tables on which he places the molds as rapidly as they are completed. Each mold as it is placed on the table pushes the preceding mold ahead of it until the table is full. At the far end of the tables is an overhead trolley, on which the hot metal is brought to the tables from the cupola. Below the tables, and at the end nearest to the molds are two conveyors, one for removing the castings as they are shaken out of the molds, and the other for conveying the used sand to the tempering and conditioning machinery. A grating placed over the sand conveyor and between the roller tables serves as a shaking-out table.

In the operation of this system, the molder, as he lifts each mold from the machine, lands it on the roller table without moving from his place. He simply makes a half-turn, pushes the mold on the table, picks up an empty flask, or removes the snap flask as the case may be, turns back to his machine and starts a new mold. The working time of the molder and his

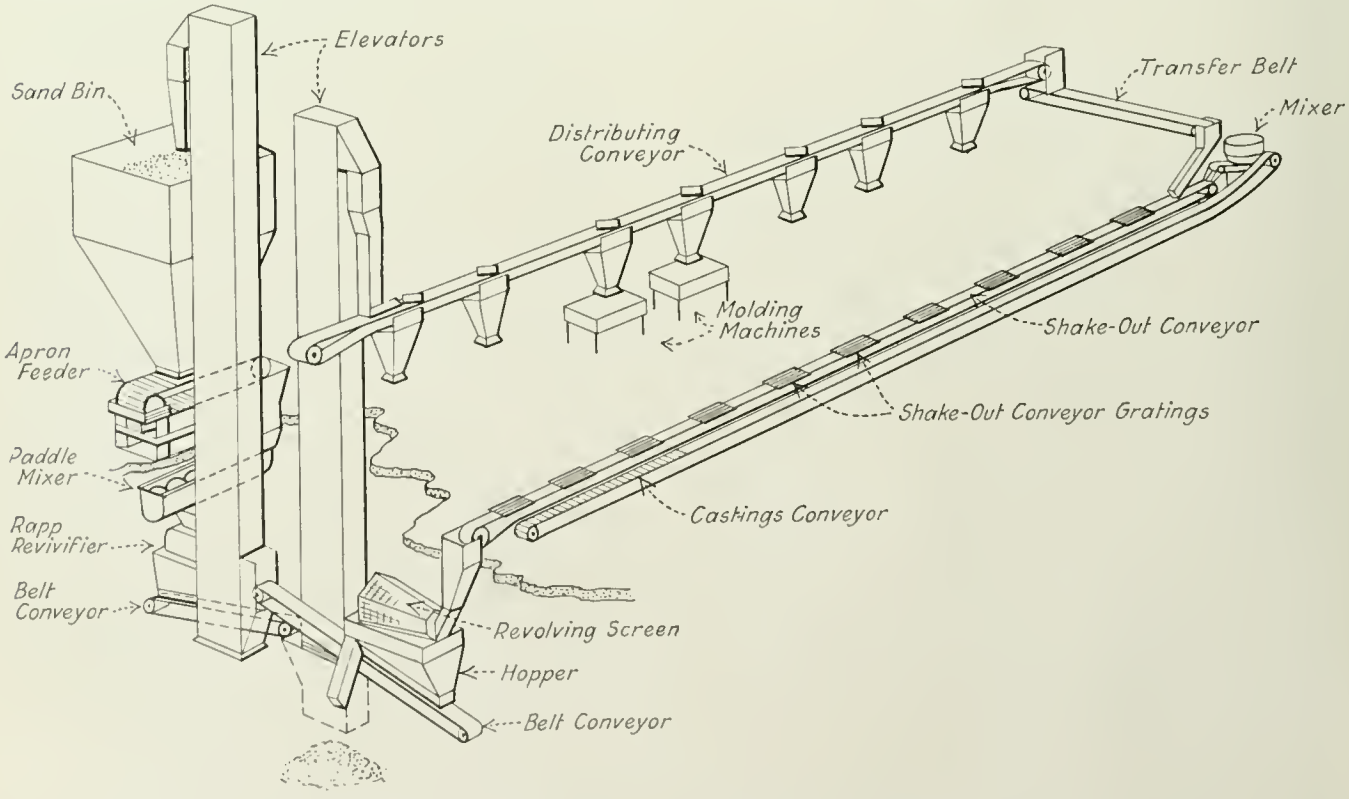

FIG. 3 DIAGRAMMATIC ARRANGEMENT OF CONVEYORS, ELEVATORS, AND SAND CONDITIONING EQUIPMENT IN FOUNDRY OF STROMBERG MOTOR DEVICES CO.

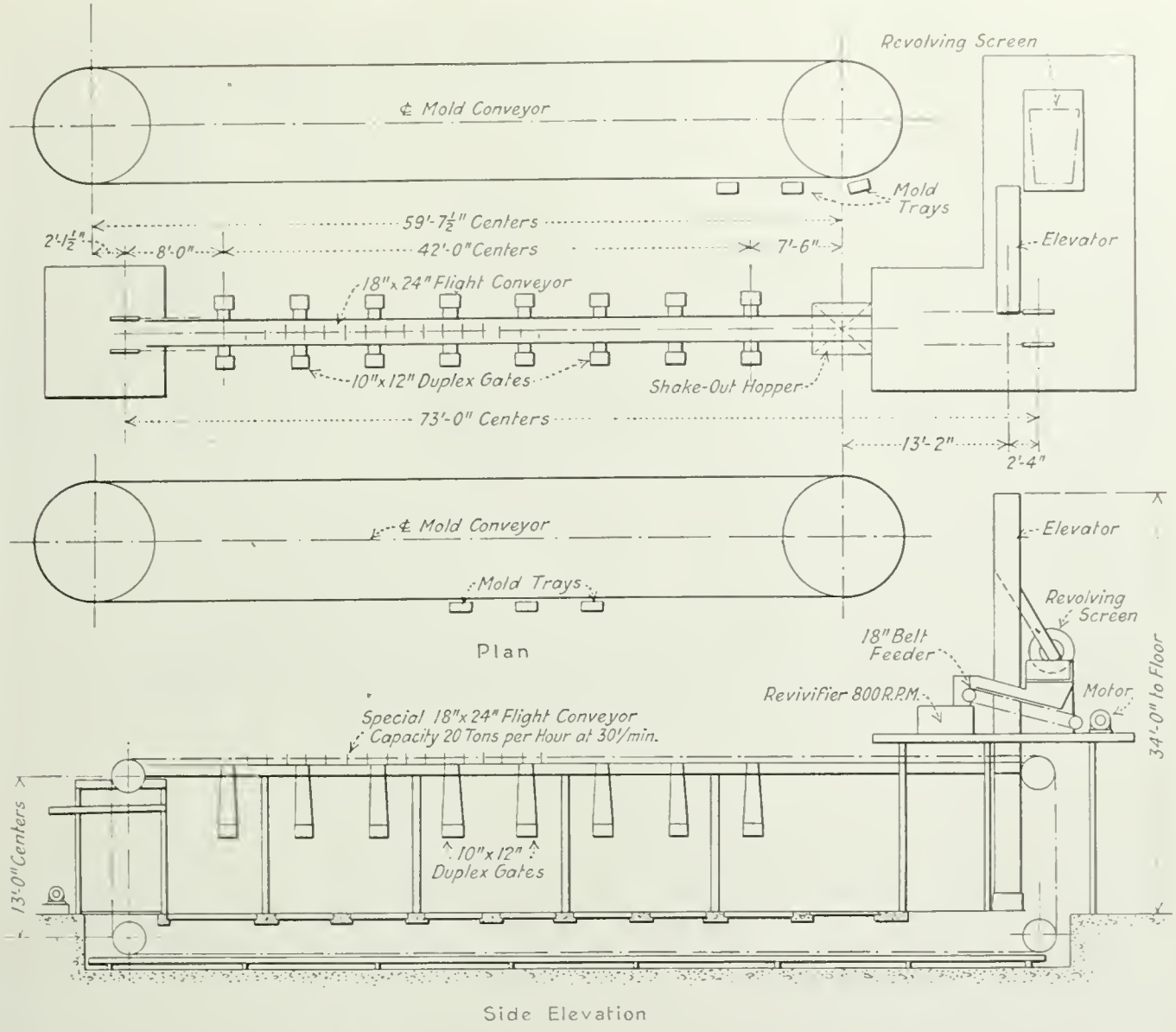

FIG. 4. PLAN AND ELEVATION OF SAND AND MOLD CONVEYORS AT KELSEY WHEEL CO.

machine is practically 100 per cent of the full working day.

The cupola is in continuous operation and metal is available at all times for pouring the molds. When one of the roller tables has been filled, a pouring crew brings a ladle of molten iron to it, by means of the overhead trolley, and pours the molds. When the castings have cooled sufficiently to permit their removal from the molds, a shaking-out gang breaks the molds open on the grating, the sand falling through to the sand conveyor, which is in continuous operation, and thus is immediately removed to the tempering machines, whence it is distributed by a belt-conveyor to the bins over the molding machines.

This arrangement, then, has accomplished several things that make for plant efficiency and high return on the investment. It has provided the possibility of almost completely eliminating the idle time of equipment and men. It has made it possible to keep high-priced men at high-priced work, and has had the heavy,

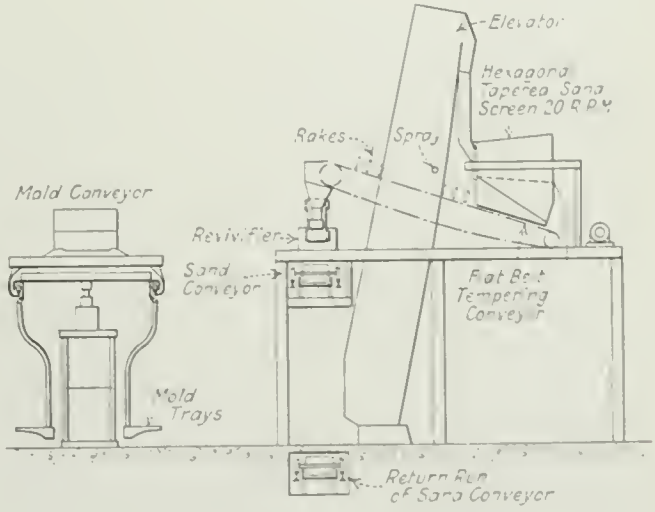

FIG. 5. END ELEVATION OF CONVEYORS AT KELSEY WHEEL CO.

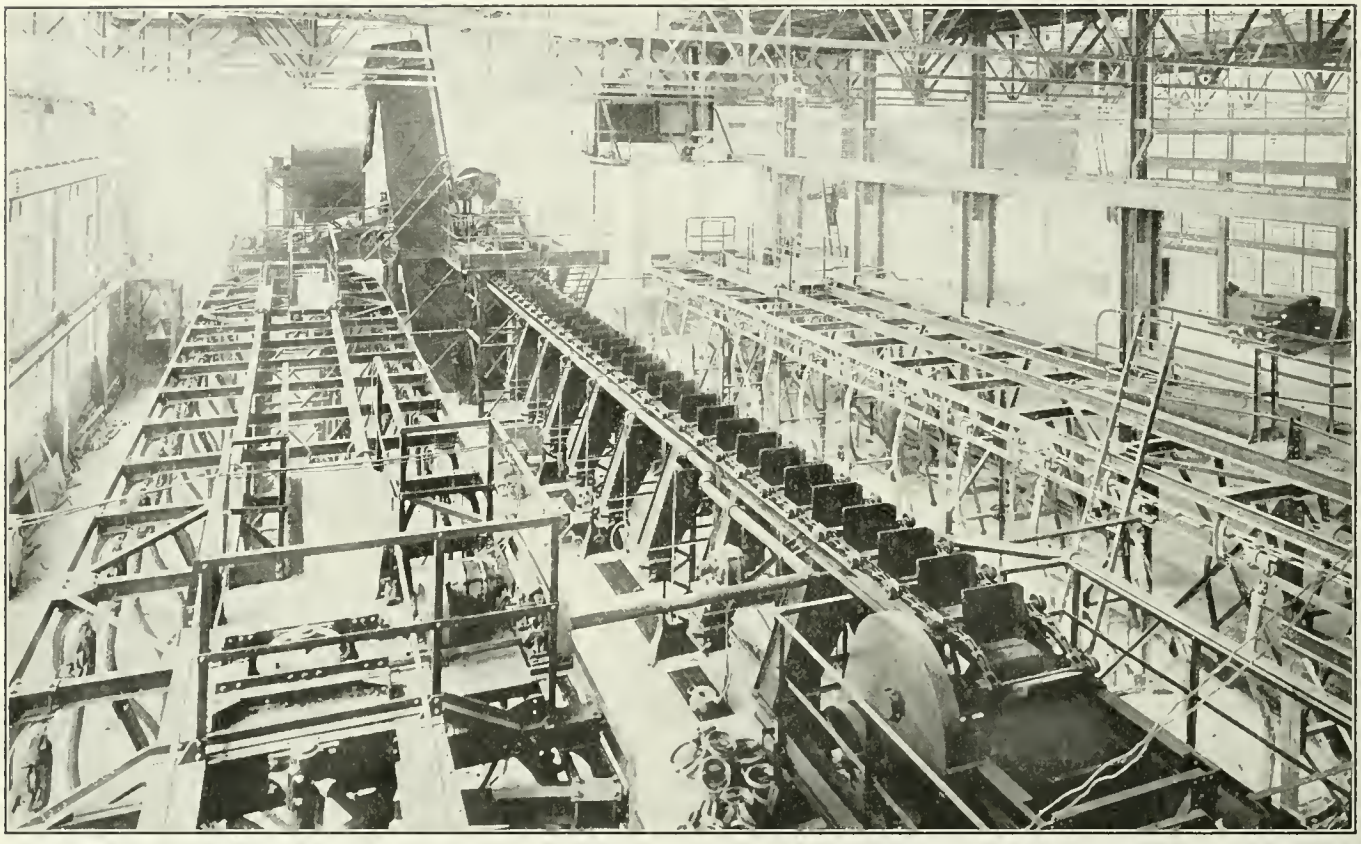

FIG. 6 SAND CONDITIONING MACHINERY AND CONVEYOR (CENTER) AT THE WHEEL FOUNDRY OF KELSEY WHEEL CO. Note the Mold Conveyors at Either Side of the Sand Conveyor.

low-priced work done by low-priced men. It has eliminated a heavy investment in ground space and buildings, by doing away with the pouring floor which is idle the greater portion of the day. It has diminished the investment in equipment by enabling a smaller number of molding machines to supply the needs of the plant, and by permitting the use of melting equipment of lower capacity than would be needed if the entire daily product were to be poured off in one or two hours.

Efficiency of the Old-Style Plant

Let us return now to a consideration of the foundry described earlier, which operates according to the commonly accepted precepts of the foundry industry, and see just how its restricted output affects the cost of production and the investment in equipment. We will assume that the foundry does all of its work on molding machines, for the reason that even on jobbing work where there are but a few castings to be made from each pattern, it is possible and economical so to rig up that all work can be put on the machine. This procedure will at once reduce the labor cost per pound of castings and render possible a large increase in the output.

The deficiencies of the usual arrangement are numerous, but two prime causes of loss of production can be discussed briefly. In the first place, the molding equipment is in service for a maximum of but 6 out of the 8 hr. of the working day, or even less if the time lost in carrying completed molds to the pouring floor is taken into consideration. On the basis of 5 hr. spent in molding and one hour lost in carrying molds, the molding efficiency is, at best, 62.5 per cent. Other delays that are possible of elimination may easily so reduce the time spent by the molder in making molds, that the molding equipment is idle, on an average, half of the working day. This means that the foundry has double the investment necessary in molding equipment, or that, for the equipment installed, double the tonnage of castings could be made.

In the second place, the melting equipment operates from about half-past two in the afternoon until an hour or half-an-hour before quitting time. That is, it is actually producing hot metal for castings only for about 2 hr. per day, and its efficiency from the standpoint of time is only 25 per cent. In other words, the melting capacity installed is four times as large as necessary, if it could be used all the time, or four times the tonnage, at least, of castings could be made with the same melting equipment. It will be recognized that, in order to overcome this loss of efficiency in the melting end of the foundry, continuous operation of the cupola or melting furnaces is necessary.

Continuous operation is not altogether a new thing in the foundry. It has been practiced successfully for quite a number of years in the manufacture of cast iron pipe, and also for the making of car wheels. It has also been used successfully for other classes of work where the daily output runs into large tonnages of castings, both large and small. It has, however, been generally held to be a large-tonnage proposition, and

wholly inapplicable to the foundry making a comparatively small quantity of castings. Nothing could be further from the truth. The small foundry can operate with continuous melting just as successfully as the large one, providing the proper equipment is installed. And this equipment will consist almost solely of mechanical handling devices of the character illustrated in Fig. 1, which will take the molds to the hot metal as soon as they are made, remove the molds to a shaking-out table while they are cooling, convey the castings to the sorting and cleaning rooms, and the sand to the conditioning machinery and thence back to the molders.

Having now discussed the physical features of the two types of foundry operation under consideration, we are in position to examine the financial side of the question. Let us assume a foundry making a moderate tonnage, say 36,000 lb. of castings per 8-hr. day, the castings having an average weight of 30 lb., and being put up in a flask 12 x 18 in. Under the ordinary method of operation, these molds can be put up at the rate of 20 per hr., which includes the time required for the molder to carry them to the pouring floor. At the outside, the molders can work at molding for not over 6 hr. per day, the remainder of the time being spent in pouring off. Each molder, therefore, will put up the molds for 3600 lb. of castings, indicating a force of 10 molders as necessary. The castings are reclaimed from the sand, and the sand cut over and tempered by two men working at night after the molders have gone home. Molders' wages may be taken as $7.20 per day, and the wages of the night men as $4.80 per day.

To melt the iron for 36,000 lb. of castings in 2 hr. in the afternoon, a 48-in. cupola is required, and to operate this a force of at least 8 men is needed. These include the cupola man, laborers in the yard for loading coke and iron on the charging buggies, buggy men for moving the coke and iron, and men on the cupola platform for charging. The wages for all of these men will amount to, say, $40.80 per day. While all of these men would not be required at the cupola all the time during the day, they would be needed around the foundry for moving sand for other purposes, and their wages are a fair charge against the method of operation.

We then have a labor cost of $122.40 per day for the making of 36,000 lb. of castings, divided as follows:

10 molders at $7.20 each	$72.00
2 laborers for shaking out, etc., at $4.80 each	9.60
1 cupola man	7.20
7 laborers for cupola and general work	33.60
Total	$122.40

If roller tables, trolleys, conveyors, sand conditioning apparatus, and sand bins are provided according to the arrangement in Fig. 1, the molder will be relieved of the carrying of molds to the pouring floor, and of all shoveling of sand. Under these circumstances, an output per man of 25 molds per hr. may reasonably be expected. Since under this arrangement, the molders work at molding for the full 8 hr., each man will put up the molds for 6000 lb. of castings, and 6 molders will do the work that formerly required 10. Pouring and shaking out will proceed simultaneously with molding, and a force of 4 men can easily handle this work. The wages of these men can be taken at $4.80 each, or a total of $19.20 per day.

Since the cupola melts iron during the full 8 hr., instead of concentrating its work into 2 hr. in the afternoon, one of much lower capacity can be installed. A 27 in. cupola will be large enough, and it can be handled by a force of 4 men at a total wage cost of $21.60 per day. The total labor cost for 36,000 lb. of castings, when adequate handling machinery is used then will be as follows:

6 molders at $7.20 each	$43.20
4 men for pouring and shaking out, at $4.80 each	19.20
1 cupola man	7.20
3 cupola laborers, at $4.80 each	14.40
Total	$84.00

There is thus a direct saving in labor cost by the installation of mechanical handling equipment of $38.40 per day. But this is not the only saving. The smaller cupola represents a saving in investment, not only in the smaller cupola itself, but also in the smaller blowing machinery required, and the lighter equipment for handling iron and coke.

With the usual arrangement of the foundry, where the molds are spread out on the pouring floor, each one of the 10 molders in the foregoing example would require 225 sq. ft. of floor space for his completed molds, or a total of 2250 sq. ft. of pouring floor. With the revised arrangement, the roller tables at each molding machine would require not over 65 sq. ft., including the pouring aisles between them, or a total for the 6 molders of 390 sq. ft. The difference of 1860 sq. ft. will represent a saving in the investment in building of approximately $5000.

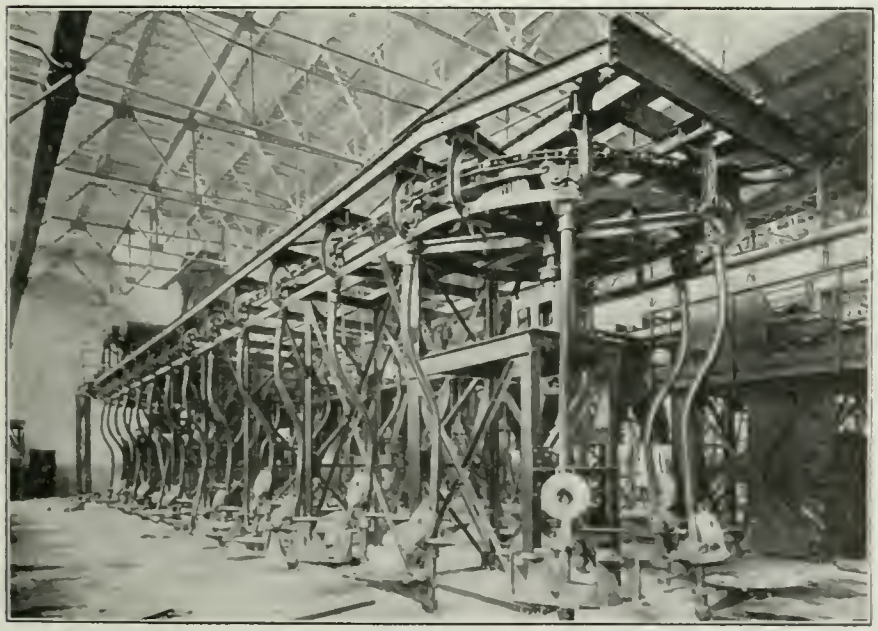

FIG. 7. MOLD CONVEYOR AT THE WHEEL FOUNDRY OF KELSEY WHEEL CO.

Against these savings there must be set the cost of the mechanical handling equipment, which for the case outlined might run as high as $12,000. This includes the roller tables, the conveyors and elevators, for handling sand and castings, a sand mixing and revivifying machine, and the overhead bins for sand storage.

We then can recapitulate the economies possible in the case outlined above as follows:

	Without Conveyor System	*With Conveyor System*
Number of molders	10	6
Number in pouring and shake-out crew	2	4
Number in cupola crew	8	4
Labor cost per day	$122.40	$84.00
Floor space for completed molds, sq. ft.	2250	390
Increased investment in building	5,000.00	...
Increased investment in molding and melting equipment	4,000.00	...
Cost of conveyor system	.....	$12,000
INTEREST, DEPRECIATION, MAINTENANCE AND OPERATING CHARGES		
On conveyor system, per year	.....	$3,000
On increased investment in building	$500	.....
On increased investment in meltiug and molding equipment	1,200	.....
Increased labor cost ($38.40×300 days)	$11,520	.....
Total	$13,220	$3,000
Net saving per year		$10,220

The arrangement and operating plan suggested in the foregoing paragraphs is not an untried idea. Fig. 2 shows a portion of the foundry of the Stromberg Motor Devices Company, and Fig. 3 is a diagrammatic layout of the conveying equipment, with the roller tables and the hot metal equipment omitted. The system was designed and built by the Link-Belt Company, Chicago. The molding machines are located beneath the bins under the distributing conveyor, which keeps them filled with sand. Any excess of sand over the needs of the bins is delivered to the transfer belt, which returns it to the storage bin *via* the shake-out conveyor. Castings are shaken out of the molds on the grating over the shake-out conveyor. This delivers the sand to a screen which removes lumps and any pieces of iron that may have fallen through the grating. The screened sand is tempered and delivered to an elevator which raises it to the storage bin under the roof. An apron feeder at the bottom withdraws the sand to a paddle mixer whence it passes to a Rapp revivifier which conditions it for use. A belt-conveyor transfers the sand from the revivifier to the boot of the elevator which delivers it to the distributing conveyor.

An interesting commentary on the production efficiency of this system is the fact that the foundry as originally built provided for double the number of molders that are now employed. The production of the smaller number of men is just about twice that expected from the larger force. It should be noted here that the figures given above in the analysis of the financial possibilities of this method of foundry operation were *not* drawn from the Stromberg installation.

We have seen how the use of mechanical handling devices makes possible a large increase in output and a substantial decrease in costs in the foundry of comparatively small tonnage on medium-sized castings. We will now consider the same methods for the foundry making large tonnages. The Kelsey Wheel Company has accomplished a production of 1600 wheels for Fordson tractors in a 9-hr. day, and has stated that with the same equipment 2000 wheels could be made if necessary. But 10 molders were required for this tremendous production, and the floor space utilized was only 10 per cent of what would have been necessary without the mechanical handling machinery. The same general principles were observed as in the case previously cited, namely the handling and tempering of sand by machinery, the use of molders only for molding, the removal of molds by conveyors to the pouring station as rapidly as they are made, and the handling of hot castings by conveyors as soon as they are shaken out of the molds. Continuous pouring is an essential feature of the process, and this alone doubled the capacity of the foundry. Continuous pouring would not have been possible, however, without the facilities for rapid molding and immediate handling of the molds.

The arrangement of the molding and pouring facilities of the Kelsey plant is shown diagrammatically in Figs. 4 and 5, while Figs. 6 and 7 are photographs of the interior. The essential features of the Kelsey plant consist of a sand conveyor of the roller flight type, delivering conditioned sands to bins serving two rows of molding machines below and on either side of it, and 2 mold conveyors, one on each side of the sand conveyor. This installation also was designed and built by the Link-Belt Company.

The mold conveyors consist of mold trays suspended from an overhead track and driven by roller chain. The trays are spaced 5 ft. on centers. Molds are placed on the trays as they pass the molding machines, and they are poured at the far end of the conveyor. The castings solidify while passing along the back run of the conveyor and are shaken out on a grating over the lower run of the sand conveyor at the near end.

The sand conveyor on its lower run passes below the floor, and delivers the sand to an elevator which discharges it to a screen. From the screen it goes to a tempering belt where the requisite quantity of water is added, and where at the same time it is rabbled by rakes set over the belt. It then passes through a Rapp revivifier, which conditions it and delivers it to the upper run of the sand conveyor for distribution to the molders.

The illustrations given are sufficient to show that vast improvement is possible in the operation of foundries as they are commonly run. It is not necessary that a foundry operate continuously on heavy tonnages to make it profitable to install apparatus that will reduce the amount of manual labor heretofore thought indispensable to the melting and casting of metals. Few foundries are so small that it will not pay to install equipment that will enable skilled workmen to devote their whole time to the work that they are best fitted to do, nor are they so small that they can do heavy handling of material more cheaply by men than by machine. The investment involved does not run into large amounts of money, except in the cases of very heavy tonnages, and in every case the return in wages saved and lower costs is more than interest, maintenance, depreciation and operating charges.

The Factors of Production

I—"Economic Problems of Industrial Organization"

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Index Number
33 Economics
338 Production

In this article the economic system is vividly pictured as a vast machine for turning out goods and services, providing the shelter, clothes, fuel, food, and amusements which make existence possible, comfortable, and pleasurable.

Natural resources, capital, labor supply, and organizing ability are indicated as the chief factors of production. The author analyzes the constituent elements of the individual business unit and indicates the part played by specialization within the unit.

THE technical aspect of the revolution which transformed the economic life of Western Europe and which has played a controlling part in American economic development has been described in earlier articles of this series.[1] It has been shown how the great inventions of the latter eighteenth century and the ensuing technical division of labor and transfer of skill furnished the foundation of mechanical mass production. It is no exaggeration to say that the development of this type of production exerted a more profound influence on human life than did the fall of Rome. In importance it transcended any political revolution that the world has ever witnessed. The introduction of power-driven machinery and all that flowed from this fundamental innovation brought about in Western Europe within a period of 100 years economic changes more striking than any that had occurred during the preceding 2000 years. The life-supporting capacity of the earth was doubled or trebled as a result of the remarkable increase in the productivity of labor which new tools and methods made possible.

The changes in the methods of manufacture, in plant organization, and in the daily tasks of individuals which these new methods of production involved have been explained, and certain of their social implications suggested. No less profound and far-reaching were the alterations in the economic bonds which tie together individuals and individual industrial units—in the channels of buying and selling, in the relations between employer and employed, in the countless connections which bind into a *system* all economic agencies. A new economic order was brought into being by the transformation of mechanical bases of production.

The steps by which this new economic organization has been effected are not of immediate concern to us; our present interest lies in the existing system. It is the purpose of the present and the immediately succeeding articles to give an account in brief outline of the structure of the present economic system, describing the elements of this system and explaining how the various parts are tied together to constitute a unified whole.

Engineers and business men engrossed in the administration of individual industrial and business units not infrequently lose sight of the broader outlines of the organization of which they are parts. Yet the functioning of this organization as a whole affects their individual activities so vitally, its smooth operation is so necessary to the economic well-being of the individual units, that an understanding of its fundamental characteristics is essential to efficient industrial leadership.

It is no extravagant figure of speech to call the economic system itself a vast machine. It is just that—a machine for turning out goods and services, for providing the nation with the shelter, clothes, shoes, fuel, food, transportation, and amusements which constitute the necessities and the amenities of existence. Into the hopper flow the raw materials of production—human effort and natural resources—and out at the other end flow goods and services in consumable form. The real income of a nation in a given year consists of the total volume of goods and services which flow out, the automobiles, beefsteaks, tons of coal, and bushels of wheat which satisfy our wants. The smooth co-operation of all the parts of this great machine—coal mines, iron mines, wheat fields, steel mills, railroads, banks—is essential to the maintenance of the volume of production. The individual unit must be efficient, of course, but without co-ordination and co-operation between units, economic chaos will result.

The Economic Development

The history of economic development has been a history of the increasing complexity of this machine, of an increasing number of parts, and a constantly greater interdependence of parts. Local self-sufficiency has been sacrificed. A thousand isolated economic units have been welded into one, as the village community of medieval times has given way to the nation of today. The economic organization which supplies the material wants of man is today an all-embracing system, in which individual workers and individual

[1] Preceding articles by Dean Dexter S. Kimball have appeared in MANAGEMENT AND ADMINISTRATION, July 1923, p. 17; August 1923, p. 165; September 1923, p. 333; October 1923, p. 437; November 1923, p. 599; December 1923, p. 743; January 1924, p. 45.

business units are but cogs. These changes have brought a tremendous increase in productivity, but at a price. Complexity has brought greater delicacy, greater danger of breakdown, greater dependence of every part on the efficiency of every other. In this complexity and in the interdependence of economic units are found the essential characteristics of the existing economic order.

It is not possible within the limits of the present discussion to describe in detail so comprehensive and complex a system. The general character of the industrial structure may be revealed, however, by a brief account of the major economic processes, with more detailed treatment of certain specific problems.

Of fundamental importance in any such discussion are the factors upon which the wealth and economic well-being of a country depend. For the primary economic process is that of *production*. At a later point the *distribution* of the national product among the factors of production will be dealt with, but this problem of apportionment is of subordinate importance to that which is concerned with the amount of the national product, with the volume of goods available for trade and consumption. The method by which a pie is divided is important, but the size of the pie in the first place may have a more immediate bearing upon the sizes of the various pieces. A consideration of the factors upon which the amount of the national real income depends will at the same time serve to introduce other problems relating to the structure of the economic system.

Natural Resources

The natural resources of a country are obviously of first importance. Large areas of fertile soil, rich mines, well-stocked fisheries, broad timberlands, navigable rivers, and easily developed routes of land transportation, a climate which encourages toil and invigorates workers—these are basic factors of a country's wealth. Farms, factories, fleets, and workshops must be built upon such natural wealth. It is true that human effort may make up for some natural deficiencies and that interchange of commodities may atone for the absence of other resources, but in the last analysis nature controls. A scant subsistence may be wrung from deserts or steppes, but that surplus above bare physical needs which permits the development of the arts of civilization and the attainment of a reasonable degree of well-being can be secured only when natural conditions are propitious. The effect of depletion of natural resources—exhaustion of the soil, deforestation, draining of oil deposits, and the using up of raw materials—need only be suggested. It has been held by some that Rome fell because the soil of Italy became sterile.

Rich natural resources are not alone sufficient to insure economic prosperity. The ownership of these resources must be such that they may be efficiently utilized. Great estates preserved for hunting, vast areas lying idle that a lord's pleasure may be served, rich mineral deposits or fine timber lands ruined because title lay in the hands of grasping individuals who sought immediate wealth—these conditions do not conduce to swelling the national product and improving the condition of the mass of the people. Neither does that type of absentee landlordism which gives an excessive share in the product to those who perform no useful function. A form of ownership which conduces to efficient and careful exploitation of natural resources is of importance second only to the existence of such resources.

Capital, and Its Part in Production

The tools, machinery, and equipment of all sorts used in the exploitation of natural resources—in other words, the *capital* of a given industrial group—constitute a second factor affecting the size of the national income. We may, under favorable conditions, pick the fruits of nature with our bare hands, and thrive. But modern man is not blessed with such idyllic conditions. To grow wheat, to mine coal, to build houses, to make clothes, *tools* are needed. Tools, of course, are never ends in themselves. A hammer or a combined harvester will not satisfy our wants as a house or a loaf of bread will. But with the hammer and the harvester the things we want ultimately are secured in far greater quantities, or with less labor, than if they were produced without the aid of these instruments. It is the function of these tools to make human labor more productive by enabling labor to be more effectively applied. A plough is superior to a pointed stick, or to bare hands, as a means of cultivating the soil. Such tools are *Capital*. We commonly mislead ourselves by thinking of capital in abstract terms. The capital of society consists primarily of the concrete equipment which man has produced for the purpose of increasing the effectiveness of his labor—the ploughs and harrows, railroads and canals, steamships and motor trucks, steel mills and textile factories—together with the surplus of consumable goods which permits such equipment to be produced.

The original inhabitants of this continent possessed even richer natural resources than we now do, but the consumable wealth we extract in a day is greater than that which the American Indians could extract in many years. A difference in wants and a difference in the size of the population are of course partly responsible for this, but the most important factor is the tremendous difference in technical equipment. It is chiefly because of our superior equipment that the Indian's scant fields of maize are replaced by the vast stretches of the corn belt, his humble tepee by the homes, apartments, and skyscrapers which culminate in the Woolworth Building, his trails by hundreds of thousands of miles of paved roads and steel tracks, his horses by Mogul engines and touring cars. The size of the pie which is to be divided has been increased a thousand-fold by this equipment, and the safeguarding of this equipment is a prime essential to the maintenance of the present size of the pie.

The character and volume of the capital equipment of a given economic area depend upon two factors. The first of these is the technical knowledge and inventive genius of the inhabitants. The great inventions of the industrial revolution were the products of mechanically creative minds possessing scientific knowl-

edge of the properties of matter and of the forces of nature. Such knowledge and such a creative bent are essential to technical improvements in industry. But they are not alone sufficient to insure the adoption and full use of such improvements. For this, the existence of a *surplus* of goods is essential; a surplus which will permit labor to be transferred from the direct production of consumable goods to the production of capital equipment which will serve the same end—that of swelling the final product of consumable goods. The tremendous importance of such a surplus, and of the saving which permits this surplus to be accumulated, cannot be overemphasized. If in any one year we should consume the full amount of the national product, laying nothing aside to support laborers engaged in the manufacture and repair of capital equipment, the productive capacities of the country would be immeasurably impaired. Railroads would break down, factories would close, widespread unemployment would follow, and the wages of labor, together with the income of all the other factors of production, would suffer great reductions. The maintenance of the volume of saving, therefore, is fundamentally important in maintaining the volume of production.

The primary stimulus to such saving is afforded by the payment of interest. Some sacrifice, some abstinence from present consumption, is involved in saving by the mass of the people, and interest represents a reward for the conscious and disagreeable restriction of consumption which is necessary to the accumulation of the desired surplus. This traditional explanation needs some modification at present because a large proportion of the capital invested today is accumulated painlessly, through the semiautomatic increase of large fortunes and the savings of people having incomes far beyond their needs. No real abstinence is involved in such saving. It is impossible to determine even approximately the proportion of the total annual savings of a given economic group arising from this painless accumulation, but it is certain that this amount is not alone sufficient to meet the requirements of society. To maintain the existing capital equipment and to create new equipment as it is needed, such funds must be supplemented by savings which call for definite restraint. Hence the economic necessity of the inducement which the payment of interest offers.

Population and Production

The proper use of the surplus thus saved is no less important than the process of saving. The existence of such a surplus enables some members of the productive population to engage in activities other than the direct production of consumable goods. Such a surplus is fruitful if these members engage in essential indirect activities, such as the production of capital goods. But if the surplus is used to build navies, support armies, to manufacture ammunition, to produce luxuries in excessive quantities, to enable some members of the population to live in idleness, the surplus may serve a vicious instead of a useful purpose. This is not to deny that navies and armies may be necessary at times. But they are always economically wasteful, and can be justified only when they serve other valid social ends.

The third factor upon which the total volume of production and hence the rewards of the factors of production depend is the character of the labor supply —in other words, the character of the population. The problem here is somewhat different from that faced in the two previous cases, for labor is a consumer as well as a producer of wealth, and certain conditions which may be to its advantage in one connection may not be so in another. In general, of course, an increase in the total population will increase the total product, but will at the same time increase the number of consumers and thus tend to decrease the share of each. Up to a certain point the former tendency will more than offset the latter, so that a clear individual gain results from an increase of population. This is so because natural resources may be more fully exploited and because advantage may be taken of all the economies of division of labor with a larger population.

The Law of Diminishing Returns

But there is a point in population growth at which the law of decreasing returns comes into play. When full advantage has been taken of division of labor, and the resources of the country are being exploited to the limit of efficiency, as set by existing methods and equipment, additional hands will add relatively less to the national product, and the general standard of living may be impaired by a further growth of population. It is true that the opening of new resources and improvements in industrial technology may offer new possibilities of population growth. The discovery of the new world and the inventions of the industrial revolution thus served to remove old barriers to population increase in the European stocks, opening eras of unprecedented growth. But, given the constant tendency of population to increase, the point of decreasing returns is sooner or later reached again, and there is pressure toward the point at which the means of subsistence will be barely adequate. India and parts of China are thus teeming with life; the welfare of all has been impaired by the mere increase in numbers. The total product of industry and the shares of each of the factors of production in that product are thus directly affected by the total population of an economic area.

The character of the population of a given area, quite apart from its size, has an important bearing upon the volume of the industrial product. Natural aptitude for sustained endeavor of the type required in modern industrial civilization is not, apparently, an attribute of every racial type. In the absence of such aptitude that surplus beyond immediate needs which is essential to economic development cannot be accumulated. The productivity of labor depends, also, upon the native intelligence and education of the individual workers. It is true that many of the tasks to be performed in modern industrial establishments are routine in character, requiring no high degree of intelligence or education. It has been held that the development of machine production is increasing the number of such tasks. In a certain superficial sense

this is so; automatons might be admirable workers for certain purposes.

Apart, however, from the fact that the training of workers for such limited tasks, to the exclusion of wider knowledge, would constitute an unendurable denial of human rights and a blindness to social ends transcending in importance any economic aims, it is a short-sighted if not a false view of economic efficiency to deny the necessity of an intelligent and well-educated population. If our methods of production were static, if our present industrial equipment were to endure for all time, unchanged, and if the economic system as it now exists functioned flawlessly, workers possessing the minimum of intelligence required for their particular jobs might serve. But discovery, invention, and changes in industrial methods constitute the normal state of affairs. If we are sure of one thing with regard to the future it is that present methods will change, that the change will be rapid, universal, and constant, affecting every industrial process. Adaptation to change requires intelligence and trained minds. The worker trained for a single task and unable to adapt himself to new methods becomes a useless impediment, a source of economic waste. Economic productivity depends no less upon the intelligence and training of the individual cogs in the industrial machine than upon any of the other factors mentioned.

Organizing Ability and Production

As factors affecting the total volume of production, and hence the rewards and well-being of every member of the population, we have mentioned natural resources, capital equipment (and the surplus which makes such equipment possible) the size of the population devoted to industrial production, and the aptitude, intelligence, and training of the members of this population. There is one additional factor of outstanding importance. This is the amount and character of the organizing ability at the disposal of any economic group. With the increased complexity which division of labor in all its phases has introduced into the economic system, the functions of the organizer and administrator have become more and more significant and essential.

A community blessed with rich resources, adequate capital, a numerous and intelligent working force would yet be economically poor if there were not present in the population those elements of initiative, judgment, and administrative ability which are essential to the launching and directing of an enterprise. As a stimulus to the exercise of such ability society has in the past offered rich rewards to the successful business leader, and such rewards are still held out. These rewards have undoubtedly been excessive at times, unearned and undeserved. Yet this ability plays such a vital part in the functioning of the economic system as we know it that even excessive rewards have been permitted in the belief that the system as a whole was sound. We are witnessing today some limitations to these rewards, and the future may well witness further limitations. But whether such organizing ability be called forth by the lure of profits or in other ways, it is essential to the functioning of the industrial system. The size of the share of labor itself in the joint product of industry is contingent upon the presence and exercise of such ability.

Constitution of the Individual Business Unit

The factors upon which the productive capacity of a country depends have been discussed above in general terms, as these four agents appear, in the large, in the functioning of the economic system. But in the actual working of this system these factors are brought together in a multitude of small units, which constitute the elements of the national economic structure. The various individual establishments which are links in the chains of production and distribution are themselves composites of these four factors, and some of the major economic questions of the day center about the problem of securing harmonious co-operation between these agents.

The task of combining these diverse elements, as has been noted, falls to the organizing and directing factor in industry which is called *business enterprise*. This task is not merely the bringing together of land, labor, and capital. It means in a specific case the securing of proper land and suitable materials, qualified labor, and appropriate capital equipment, and the welding of these factors into a productive unit in the proper proportions for the given purpose. How much capital may be profitably employed? What kind and what amount of labor should be secured? How much land is needed? How may labor, land, and capital be made to work harmoniously together? What system of organization shall be employed? How shall the problem of mass management be met? These are problems which in the past have not been solved generally either by investors of capital, laborers, or owners of land, as such. For their solution there has been called forth the separate organizing factor, business enterprise, which buys or rents land, purchases raw materials, hires labor and borrows capital, and combines them effectively into a producing unit. This factor may take any one of a number of forms, of which the individual enterprise, the partnership, and the corporation are most common.

Division of the Social Product

In the organization of the business unit there is not always the clear-cut distinction between elements which has been assumed in the above description. Actually, certain of the factors shade into each other in many cases, and there may exist no sharp line of demarcation between the shares received by the different agents for their part in production. Thus the single business man may own his own capital and may perform a great deal of the labor necessary to operate his business. It is often impossible to separate business profits from the wages of management, or economic rent from interest on capital. But the outline given, simplified as it is, may serve to make clear the structure of a productive unit in industry, and to indicate the nature of the problem that arises in dividing the social product. This latter problem will be the subject of more detailed discussion at a later point in this series of articles.

The characteristics of the modern economic system are revealed in part in the structure of the individual business unit, as described above. But for an understanding of the economic order as a *system* it is necessary to comprehend the nature of the ties which bind these individual units together, making of them an immense, complex and finely articulated whole. These ties, in their number and diversity, are the most distinctive features of our present industrial system, rendering it more efficient and at the same time more sensitive to disturbances than any other economic order the world has ever known.

Ties Between Economic Units

The connections between units in the economic system are not all direct, visible, and obvious. A trader or manufacturer is tied to the business world in which he operates by a complex variety of bonds, of many of which he is quite unaware. Yet these ties are all-important. The existing order, in its peculiar susceptibility to crises, to business booms and depressions, in its characteristic reactions to disturbances in every part of the economic system, bears witness daily to the variety of these channels of communication and to the extent to which they permeate the business world.

The modern price system is perhaps the most important factor in this tying together in a complex whole of the various parts which may be so widely separated geographically or functionally. The nature of these price connections will be the subject of the succeeding article. Certain other direct and important relations may be indicated.

Nature of the Industrial System

The industrial system may be viewed as consisting of a number of parallel channels, down which the products of industry flow. There are numerous interconnecting canals, but the broad channels down which the main streams flow are of primary importance, and trace out the most significant economic relations. Such a channel has its source in a given extractive industry —in wheat fields, iron mines, lumber camps, cattle ranges, or cotton plantations—where the raw materials are obtained from the earth. Thence the materials flow downward to their ultimate destination, the final consumer, passing through the hands of middlemen of various degrees and kinds, transportation agencies and manufacturing concerns. Storage elevators, warehouses, and various contributory services such as banks, insurance companies, and exchanges may intervene to assist in the process. Each route is characterized by a close interrelation of parts, and by numerous and intimate points of contact with routes in other industries. The channel may be direct and simple, or devious and complicated. In general, the development of modern methods, with increased division of labor, has increased the complexity of the course which goods follow, though the movement toward integration, or vertical combination in industry, constitutes a tendency toward simplification. The industrial system is simply an organization of many such channels along which goods of diverse types move, to be belched forth at last as finished products when all processes have been completed.

Such a view of the economic system indicates the character of some of the interrelations between units, but it does not suggest all the ties which connect the individual business unit to the other parts of the system. Apart from the ties resulting from direct buying and selling relations, the force of competition sets up bonds which act as connecting links between the various parts of the economic structure. It is through such links as these that influences originally affecting one part of the economic system are transmitted to other parts, making the business cycle, for example, a phenomenon which touches all elements of the business world. Competitive ties of four general types may be distinguished. Perhaps the most obvious relations are those which center about the selling market of a given concern. Here there are direct and unavoidable contacts with all concerns producing the same or similar articles or selling the same or similar services. In buying its raw materials and equipment it comes again into competition with numerous industrial units. In hiring labor and in seeking to retain its own working force it is constantly in competition with other units. And, finally, in tapping the funds of capital and credit which play such an important part in modern industry a business or industrial unit comes again into active competition with other units. Thus on all sides a given enterprise is tied to others; isolation is unthinkable. It is an integral part of a system.

Specialization in the Economic System

The development of this system of closely correlated parts has resembled in many ways the growth of specialization within the single unit. The part that technical division of labor—division of labor within the factory—has played in industrial development has been fully explained in earlier articles. Technical specialization, minute division of function, has uncovered hitherto undreamed of productive capacities, and has made possible the astonishing advances of the nineteenth and twentieth centuries. No less fruitful has been the similar process of industrial and geographical division of labor which has brought about the existence of these numerous parts in the economic system. But, just as technical division of labor within a manufacturing establishment intensifies the difficulties of administration, and makes the smoothest co-operation essential to efficient production, so the industrial division of labor has made the task of co-ordinating the economic processes of society perhaps the most difficult economic problem of today, as it is the most vital to economic well-being. That fine adjustment of parts which is required in the operation of a delicately constructed machine must be secured for the efficient functioning of the economic system. The degree of co-ordination which is actually attained is remarkable, in view of the diversity of interests pursued by the millions of individual workers included in the system, but the co-ordination is still imperfect. To secure more perfect co-ordination, and to learn to control more effectively the machine as a whole—these problems remain for the present generation to solve.

THE EDITORS' PAGE

The Shift in Buying Responsibility

THE adoption of the budget system of pre-estimating expenditures and establishing their control is strengthening the tendency to push the responsibility for purchasing higher up in the operating and executive groups. This situation is particularly true of major items of plant equipment.

Fordham and Tingley describe the newer practice with unusual clearness in their series of articles on "Control Through Organization and Budgets". On page 60 of the January instalment, referring to the compilation of a budget, occurs this statement:

> Before the plant section can submit its requirements for the budget, it is necessary that the supervisors of the other sections notify the plant supervisor of all the work they desire done during the next month's budget period. Then he has his foreman prepare a list of the materials and the man-hours that will be required for all the work requested. In advance of the date for submission of budget figures a meeting of the manufacturing division superintendent and his supervisors is held to determine which items of plant maintenance work or departmental changes, etc., as requested, will be approved for the next month's budget.

A budget once approved and submitted cannot be altered without the approval of the controller, and in some cases it is made out to cover more than one month. Quoting again with reference to the manufacturing division:

> Another estimate is made in similar form of the requirements for the two months in advance to enable the controller to forecast the cash requirements and operating expenses for such a period.

Such methods are in line with the principle of "make your plan, then work your plan". They are a major step in checking wasteful expenditures and securing economical operation. But they are upgrading the responsibility for buying, and creating a necessity for a new form of sales appeal.

Before this shift of the final "say so" for purchasing materials, supplies, and equipment began, much of the responsibility for selecting and requisitioning rested upon the foremen and minor executives. They ordered largely on "hunch". To their credit many of their hunches were good, but it is doubtful if they could be defined before a board of directors, for the simple reason that proved facts of investment charges and savings were unknown. The technical advantages were usually the only ones considered.

Today, in progressive plants under budget and controller systems of management, the economic facts are being studied before a decision to purchase is made. The responsibility to buy is being placed higher and higher in the operating organization. No one should be disturbed over the situation, rather it should be welcomed, for the spread of responsibility means better and more profitable operation.

The Place of the Business Magazine

NO good business man neglects his own trade paper. The publication gives him immediately essential information regarding his own line of business. When, however, it comes to business magazines of wider scope or of more general application, he is not so attentive. As a correspondent writes: "Your magazine is good. I ought to read it, of course, but I haven't got time".

The reason for this attitude on the part of the executive is easily discovered. The routine and special duties that press upon him must be attended to, or there is quick and serious trouble. The current information and special services offered by the magazines may, in the long run, be quite necessary to the success of his business as the performance of many of his other executive duties, but the magazine can be postponed without immediately serious results.

It must, however, be remembered that no "in-growing" concern is ever permanently prosperous. Success is not spun from the inner consciousness alone, but depends largely upon a knowledge of outside conditions—of what others are doing. It is in this direction that the magazine serves. The average business executive cannot give time, even if he had opportunity, for the outside contacts that would give him this knowledge. The magazine here comes to his aid, bringing him the culled experience and opinions of the best business minds in the country.

It is true that it takes time to get this information from the magazine, but its demands are not excessive. The executive is not supposed to sit down and read the magazine from cover to cover. That would be interesting and it might be very valuable, but it is not necessary to get the greatest part of what the magazine has to offer. In fact, most readers merely "flip" through their magazines, noting as they go any matters of special interest, perhaps dipping here and there to take in a few paragraphs, or it may be stopping to read and study some chart or article of unusual or immediate practical interest.

This "once-over" does not take long, and the magazine then goes on—perhaps to other readers, or to the shelves for binding when the volume is completed. In many cases, it is cut up and the articles of more direct interest are filed under the proper index number so that they are easily found when the need arises. The larger establishments subscribe to a number of copies of any specially valuable magazine so that all these various functions may be discharged simultaneously.

The business magazine, properly used, is an important factor in business success. It is easily brought into play and its very real value should not be overlooked.

Securing Additional Capital

RECENTLY a correspondent wrote us in reference to securing additional capital for a small going concern. His letter was published in the Reader's Page of MANAGEMENT AND ADMINISTRATION for December. As stated by our correspondent: "We are paying expenses with fair comfort; but are not making money—that is, after salaries have been paid and proper reserves set aside, there is practically nothing left for surplus".

If he can increase the business so as to carry over this "dead center" profits would be adequate. But this requires $50,000 more of capital and he finds it difficult to secure this. "We cannot put in any more ourselves; we have not sufficient standing to sell stock or bonds. Is there any other way out?" New York brokers had already been written to but had declined to undertake the task of raising the additional capital needed, stating that the issue was too small to interest them.

The inquiry has attracted so much attention as clearly to indicate that this condition of "non-elastic" self-support is common. As another correspondent commenting on the inquiry says:

> The question raised in this article is of very much interest to me and as your correspondent states—"There must be others in the same predicament". I am writing this note to say that I hope you may find space in the magazine for any letters which give any new lines on this question. Of course, in such a case many suggestions may be repetitions but this question of raising additional capital for a man in the neighborhood of $50,000 without a bond or stock issue is one of great practical importance to business men.

On the Reader's Page of the current issue of MANAGEMENT AND ADMINISTRATION appear several letters in answer to our correspondent's inquiry, suggesting methods whereby the desired capital may be secured —or otherwise, meeting this same need by more efficient use of the present capital. In the March number more of these letters will appear. All are interesting and some of the suggestions are of distinct practical value. They will repay careful reading.

Child Labor and the Law

FOR many years past friends of the children have endeavored to secure legislation regulating the use of child labor. The first efforts were toward state legislation but the difficulties were such that an appeal was finally made to Congress, and federal legislation regulating the employment of children under the age of 14 was twice secured. In both cases, however, this legislation was pronounced unconstitutional by the Supreme Court. At the present session of Congress a determined effort is being made to secure such legislation as may be now possible to alleviate the conditions of child labor, and at the same time constitutional amendments are being introduced that will, if they are finally adopted, enable Congress to enact really adequate child labor laws.

There is much to be said in favor of such legislation, but little against it. Child labor is not, in the long run, desirable or economical. Even the child of 14—the usual age limit of child-labor restrictions—is not capable of doing good and systematic work and, as a rule, employers will not take the time to train him. Accordingly he is employed at "dead-end" jobs which lead nowhere. He is, naturally, not content with such work and drifts from job to job, running up a startling labor turnover. In 1920 the Consumers League studied the records of 253 children who had been at work a little over a year and found that during that time they had held 589 positions. Of these 165 positions had lasted from 1 to 29 days; 164 lasted between one and three months; 141 between three and six months.

The argument has been brought against restriction of child labor that it interferes with the apprentice system and limits the supply of apprentices. There are few, if any, trades that will take apprentices under 14 years—that is, where the apprenticeship is real and not just an excuse for securing an odd-job boy. In the building trade, as in many others, 16 is the usual apprenticeship age.

But few, if any, modern executives will be found to object to child labor laws. Humanitarian and sociological reasons aside, they realize that the careless and ineffective labor of young children is not economical—that, on the contrary, it is a menace to the efficiency and discipline of the whole factory. Older, more responsible, and better-trained labor at a much higher price is cheaper.

Government Reorganization Will Aid Industry

FOLLOWING close upon the Mellon plan of tax reduction, which in some form a determined public will undoubtedly force Congress to pass, comes another big proposition which will save annually another $100,000,000 of the government funds. This proposition is one of importance to industry, and has had the strong endorsement in principle, of both President Harding and President Coolidge. It is the reorganization of the Department of the Interior.

Briefly, the effort is directed toward the concentration in one division of all the non-military construction and engineering work now conducted by no less than 34 distinct government bodies. The present Department of the Interior would be organized into two subdivisions, one of Public Domain and one of Public Works.

After the change industrial managers will have one central bureau to deal with in selling supplies to the government for construction and engineering activities, instead of the present 34. Standard plans and specifications will be developed for materials and manufactured products desired, and every industry will save large sums because of this uniformity and on account of simplified commercial negotiations with the government.

The reorganization is being urged by the American Engineering Council in conjunction with architects and contractors, and a bill will be introduced into the present Congress in the endeavor to bring it about.

THE READERS' PAGE

Securing Additional Capital

SEVERAL suggestions have been received by the editors toward the solution of the financing problem stated in a letter printed, without signature, in the December issue. The letter was from the manager of a manufacturing company doing a business of about $200,000 a year, working to the limit of its available capital, but needing special financing of about $50,000 to carry it over the "dead point" of its development. One suggestion is from L. H. Allen, C. P. A., Vice-president of the accounting firm of Albrecht & Weaver, Inc., of Buffalo:

Editors of MANAGEMENT AND ADMINISTRATION:

I have read with interest the letter in your December issue entitled "Securing Additional Capital," and am moved to suggest a possible solution. Since the inquirer's letter does not reveal enough information to justify a positive expression, the recommendations which follow must be considered purely tentative.

The borrowing of capital for plant expansion is ordinarily justifiable when the following conditions are present or prospective:

1. A product which fills an economic need.
2. Plant location economically right; e. g., labor and material easily obtainable at reasonable cost, and shipping facilities good.
3. Management efficient and dependable.
4. Present output maximum possible for equipment and at minimum cost consistent with quality demanded by consumers.
5. Expansion of plant possible without excessive cost for additional space.

Those seeking to borrow should assure themselves that they are in a position to satisfy potential lenders concerning these important points, and to do this the assistance of a disinterested party is highly desirable. A survey and report by competent cost-of-production accountants and engineers should put at the disposal of the manufacturer exact information as to production and costs, as against possible results without additional equipment.

This, in the hands of his banker, might prove to be the magic wand opening the door to greater opportunity.

Finally, suppose that the banker has reached the point where he is willing to loan funds but requires collateral. Would it not be possible for the inquirer or a group of stockholders to put up their stock to show their good faith to the banker?

LEWIS H. ALLEN.

A second reaction is expressed in this letter from E. W. Stake, of 2518 Ainslie Street, Chicago:

Editors of MANAGEMENT AND ADMINISTRATION:

In response to the letter on "Securing Additional Capital," in your December number, there are several comments I wish to make.

The letter is expressed in terms so general that it is difficult to make practical suggestions without further detailed information. If the concern is not a money-maker on the capital invested it is a question whether more capital will make it more profitable.

The exact status of the case is not shown. It appears to be one requiring not merely bank credit but rather permanent invested capital. If the former were the case, I would suggest that the writer try to borrow up to $25,000 from his own bank, and also obtain an open line with another bank for the same amount. In that way he could make a "clean-up" with each bank for a fair portion of each year, keeping commensurate balances with both banks.

He might also try working two shifts at his plant. By this plan, on the same amount of fixed capital, he could produce an output close to twice as much—at any rate, as much as would be consistent with sound business principles.

As to his administrative and selling expenses, these must of necessity be somewhat increased. The weakness of the case lies in a lack of profitable turnover.

The foregoing is only a brief letter, and does not cover thoroughly all the points mentioned.

E. W. STAKE.

Still another point of view is advanced in the following communication from Dana R. Hanford, public accountant and auditor practicing at Duluth, Minn.:

Editors of MANAGEMENT AND ADMINISTRATION:

The letter appearing in your December issue under the caption, "Securing Additional Capital," interests me to the extent that I am urged to make an attempt in the general direction the writer of that letter desires.

Let me say in the beginning that I have nothing but respect for the sincerity, judgment, and real business ability of this man. He has racked his brain, and no doubt has spent many weary hours, in trying to find a solution of his difficulty. He can see no way out, and it is, in my opinion, an indication of his broadness of vision that he has put the problem before us for discussion. His situation is serious and it perhaps is not especially comforting to know that such a situation as his is far from being uncommon. If, then, I may be permitted, I should like to say some things to him which may appear even to insult his intelligence, but which are rather intended to serve as the sort of a cold shower we used to take after football practice. It seemed to take out the tired feeling and left us fresh and invigorated.

Are you sure, Mr. Man, of the premises upon which you ask us to base our conclusions? Or have you been staring at your problem so long, reviewing it in all its various angles, but seeing it through the same tinted glasses, that it has finally become imbued with the color of those glasses? Getting right down to plain English, can you be dead sure that you have not been self-hypnotized?

I can understand your attitude when you say:

"Manufacturing and selling on the present basis we can hardly expect to do better than at present."

You may be right. But do you *know?* How do you know? Who else says so? Viewed from the same old desk, with the same pair of eyes, with a thousand and one other things coming up to distract the attention; this going on day after day, week after week, month after month, it would be the easiest thing in the world for even as able a man as you, sir, to let his thoughts travel in the same old track and to come to the same conclusion every time.

Perhaps other eyes, attacking the problem from a different viewpoint, and with nothing to interrupt a concentrated attention upon your production and sales problem would discover a less somber tint which might point the way to hope for a new day of increased activities.

May I suggest, too, that the really efficient man I know you to be has long ere this fully availed himself of the services of a public accountant? I mean to direct your attention to the word "fully." I do not mean that you have merely had the usual balance sheet audit at the end of each year. I mean that you have gone to a competent auditor and have laid all your cards on the table—made a clean breast of the whole thing—and then said to him:

"I want you to go ahead and find out what is the trouble; you are to be absolutely unrestricted in your work; somewhere there must be a nigger in this woodpile, and it's your job to find it."

Many who find a degree of satisfaction in the fact that they are progressive, and feel that this is in part evidenced by an audited balance sheet at the end of each year have yet to realize that this is but a small part of the service their auditor is prepared to render. It is true that this service has in the past been the most common one, but it is also true that the world of business is now beginning to draw upon the outside auditor for services of a nature which the profession itself would have viewed as something akin to heresy not so long ago. These services include work of an analytical nature, budgeting, and the very closest of co-operation with the management.

Your auditor, sir, if he is really one of the able men who form the major portion of the accounting profession today, is quite likely to find practical ways, within your own organization, of helping you to work out your problem—provided you turn him loose without hobbles.

But, you say:

We have an auditor of the type you have in mind; we have turned him loose; he has made the fullest possible investigation; he has formulated a system of costs which gives us current information while it is still hot; he has devised an accounting system which gives us minutest control of every phase of our business; these are kept up to date all the time, and in addition to this we have a practical, working budget. More than all this, we, the management, are using this data to the very fullest extent of which we are capable.

But our problem is still unsolved. We still have to increase turnover. This requires additional capital which we haven't got and and can't get. Your suggestions are all good, but they don't help us out of our difficulty. Thank you, just the same.

Mr. Editor, this man's position is not unique. There are literally thousands upon thousands of just such firms all over the country. Intrinsically sound, they are, nevertheless, compelled to go limping along constantly hampered by lack of capital because the security market does not seem to have been developed in a manner which takes care of such cases. The banks cannot furnish them with capital other than to meet current needs, and the limit on such advances is very definitely set by their relation to quick assets.

I confess that I do not know whether the plan I have in mind is now being used, and I freely admit that its practicability may be open to question. But cases such as this one have been brought to my attention before now, and I have given them some thought.

It appears to me that a method should be found of assisting these concerns, and that it might assume the following general form:

Suppose we organize a corporation which is authorized to issue a certain amount of common stock, and in addition thereto, a gold bond bearing, say 6 per cent interest. Let this bond be an obligation resting upon such securities as may be taken over by our corporation, and let a constant campaign be waged for the sale of these bonds. The risk being wisely scattered as between industries, and the limit of bonds being established at a conservative ratio to the underlying securities, they should be a fairly attractive investment.

Now let the writer of the article which has provoked this reply come before the directors of our corporation (men selected because of their demonstrated business ability) and present his case. We agree that his presentation appears plausible, and that, he being willing to bear the expense, we will made a thorough investigation of his case. This investigation will take the form of an appraisal of the physical condition of the plant, an examination of its source of supply and the distribution of its product, a detailed audit, and inquiry into such other matters as appears advisable.

The results of this investigation being satisfactory, the gentleman is informed of the terms upon which we will finance him. These would very likely take the form of a hypothecation of certain of his assets which might be covered by a mortgage bond or perhaps merely by his corporation note.

The terms would include an adequate rate of discount on his paper, and monthly or quarterly amortization of the principal as well as payment of interest. During the life of the obligation we would maintain close contact with his organization through continuous audits and might require a seat at his director's meetings.

From the standpoint of our corporation such a plan, properly directed, should show reasonable net earnings, for the selling cost of disposing of the underwritten securities under the present methods is eliminated, those securities being locked in our vaults. Instead of attempting to sell $50,000 worth of this man's securities, we are constantly selling our own bonds, and the proportion of this expense chargeable to this particular deal is relatively small.

From the standpoint of the many concerns who are hampered under present conditions, such a plan appears wholly feasible. We may even grant that the rate of interest would be run up by the discount to what seems to be a high figure, but had it not been the combined judgment of our directors that the business could pay this interest and still continue to function? Also, that it could not only do this, but in addition could amortize its debt, eventually paying it in full? And was it not our client's earnest desire that he obtain this advance on just such terms? In addition, he must not overlook the very tangible benefits which he is likely to derive from the constant supervision of an experienced and capable body of men whose heartiest wish is that he may be able to pay up his obligations and go on his way free and prosperous at the earliest possible moment.

I shall be glad if this proposal appears to have enough of merit to invite discussion in your columns. I again admit that there may be serious difficulties in its practical working out, but surely they are not insurmountable, and there can be no question of the need for some way of assisting these concerns. The economic loss from this source must be a very considerable item.

Now, you, sir, who started this. I do not know that I've said anything new, and I may not have given you any new ideas, but I do know that your problem is a real one. I also know (and this may help you some) that *there is no problem in which we have the working out of a good result for which we cannot find a proper solution*—if we go at it in the proper manner.

DANA R. HANFORD.

The Human Equation in Business Activities and Forecasts

The following communication from Archer Wall Douglas, Chairman of the Committee on Statistics and Standards of the Chamber of Commerce of the United States, gives an interesting view of the effect of mass psychology upon business conditions and also as to the normal rate of growth in industry.

Editors of MANAGEMENT AND ADMINISTRATION:

In a recent number of MANAGEMENT AND ADMINISTRATION there is a very interesting article by Carl Snyder of the Federal Reserve Board which seeks to prove that the supposed potency of "mass psychology" in the determination of business activity is largely a "myth". Furthermore, that practically every industry or form of business activity shows a normal rate of growth if taken over a sufficient period. The conclusion being that consequently it may prove possible to construct from the statistics of such growth a reasonably safe guide for business enterprises by which to direct future operations. My own experience is so entirely at variance with both of the views set forth that I have taken pains to go into the evidence submitted, and also to place some witnesses of my own summoning on the stand for cross-examination.

Pig Iron and Soft Coal Production

Pig iron and soft coal are two commodities cited by Mr. Snyder and here is what they disclose. I took the statistics of production of pig iron from 1870 in 5-year periods for about 50 years. The percentages of increases of one period over the preceding period vary from 18 to 75 per cent with no uniformity of relative growth to be found anywhere in the periods. All that can be said is that there is continuous growth over the entire time in 5-year periods but not always in succeeding years, and the growth of one period is frequently in strong contrast both to the periods preceding and following. One of the causes affecting the figures is that of strikes, sometimes of coal strikes, sometimes of strikes at the steel works, both of which add to the irregularity of the years and the periods.

The story of coal parallels that of pig iron as to the wide differences between the percentage of increase in 5-year periods going back to 1870. They range from 2½ to 100 per cent, one of the disturbing elements being the constant and often prolonged strikes affecting production. It is rather significant that some of the smallest percentages are those of the latest 5-year periods, because it brings up the far-reaching problem of other heat and power producers, i. e., oil, and electric power derived from waterpower in which coal plays no part. Obviously the increase in coal production must be considered in relation to these other forms of heat and power if it is correctly to represent the growth of the factors of power and heating. You immediately run up against the fundamental contradictions between the possibilities of increase in oil and in the other factors of light and heat.

Oil production is purely a natural phenomenon depending for its continuance upon the discovery of new fields, which discoveries are sometimes a matter of chance, sometimes of design. In the past this is indicated in the differences between two successive 5-year periods of 20 per cent in one case, and 50 per cent in the other, and in other periods of still wider differences between extremes of 5 and 75 per cent. Meanwhile the growth of electric power for all purposes is likely to outstrip all estimates, since it will not only increase in relation to the growth of population but also of wealth, education, and intelligence. It will also be largely influenced by that human psychology which has come to regard electric lights and telephones as necessities and not as luxuries, and as a part of the equipment of modern social and economic life.

Influences Affecting Forecasts

Much the same problem presents itself as to the probable increase in automobiles in the near future as well as in the years to come. The proportion of automobiles

per capita is largest in the great plain states such as Iowa, Nebraska, South Dakota and Kansas where physical obstacles to travel are mostly absent, roads are many, and large cities are few. This same proportion also prevails in California where rivers, deserts, mountains, and forests are the natural hindrances to easy means of communication, but where good roads are numerous. For it is something more than a coincidence that the other factors of liberal automobile buying, widespread education, and a high degree of intelligence, are common to the people of all the states in question. For education and intelligence are the forerunners of wealth, and of that keen comprehension among the many of the value of such progressive factors of civilization as automobiles.

In such a homely matter as that of forecasting the probable sales of household and kitchen utensils it is found that price is often a less compelling factor than appearance, labor-saving properties, and style, for in such matters the human equation is equally a factor along with the records of past outputs.

In all the other lines of production that I tabulated and analyzed I found the same characteristics of wide variations in production between the various 5-year periods and an entire lack of uniformity of growth. In such commodities as cement, zinc, lead, copper, silver and wool there has been no growth at all in domestic production in the past 30 years, merely an indeterminate ebb and flow, with no definite movement in any direction.

Farm commodities, wheat, corn, and cotton, show the same characteristics as manufactured products, only in more marked degree. Wheat and cotton are at present on the declining scale, and the circumstances surrounding these important factors of economic life are at present so complicated and uncertain that any attempt to forecast their production even in the next two years would be mere guesswork. And yet the prosperity of the South depends more upon cotton than any other factor. In the matter of live stock there has been practically no increase for 20 years.

There are also industries, as for instance, the manufacture of malt liquors and of saddlery and harness, which show a decrease and will probably continue to do so as time goes on. Charts that record the progress of business activity must also modify the gradient of their curves by the application of the figures of industries such as these that are going down hill. It must also be noted that the business done by automobiles and motor trucks is not all of new creation, but an appreciable portion of it is still merely the transference of that formerly done by means of horses, railroads, and trolley cars.

The Past as a Measure of the Future

It seems plausible that if it were possible to construct a curve that showed with a fair degree of approximation the course of business for a long period of time past that it would also be possible to construct another curve for a similar period in the future. Certainly this could be done if the past is a true index of the future. But such a curve would, however, be only an approximation at the best, for the great variations, in 5-year periods, of increase in production in all the factors of activity I have mentioned, show conclusively that the attempt to forecast the activity of any 5-year period in the future upon the basis of any 5-year period in the past would be mere guesswork. There is no regularity of production in increase or decrease to admit of such determination.

Furthermore, it is to be noted that the different lines of production, if charted separately, do not show any similarity of movement either of prices or of production save in times of extreme prosperity or of extreme depression. In ordinary times such movements are due principally to the separate causes which affect them as lines. Even this has to be further modified; lumber, brick, cement, and structural steel are all building materials which are now active because of much building and construction, but when the keen edge of building houses and structures is dulled, cement and brick will still feel the effect of road construction in which lumber and structural steel will have small part.

Requirements of Intelligent Forecasting

Now it may be an interesting mental exercise to endeavor to forecast prices and production for the next 5 or the next 20 years, but I cannot see that it serves any useful purpose under the present difficulties attending such prophecy. What the average business man most desires is some intelligent idea of what is going to happen in the next six months, or the next year, and I do not find that this desire is meeting with much real gratification. For before we even reach this stage several things must come to pass. Statistics must be more complete and accurate than is now the case, and they must be interpreted by those who have personal knowledge of the facts that produce the statistics.

Government statistics should be, of all others, the most reliable. Yet the reverse is so often the case as to bring them under general suspicion on this score. Some of the estimates of crop yields, especially of cotton, in recent years have been so wide of the mark as to cause doubt as to the methods pursued. For instance, supposedly comparable estimates of the Department of Agriculture and the Census Bureau of the number of live stock in restricted areas, such as New Hampshire and Delaware, have differed as much as 35 per cent. My own investigations have convinced me that these discrepancies are due not so much to the methods used, as to the fallibility and variation in the human reporting element. On the other hand, there are apparently sufficiently reliable statistics in lines of production, such as cement and lumber, where there is an understanding among producers as to the collection and codifying of such figures.

As stated, there can be no intelligent analysis of statistics unless the student has sufficient knowledge of the facts that produced the statistics to detect errors both of omission and inaccuracy. As an example of this, it is assumed in general by those writing on the subject of retail distribution that the sales of department stores and of chain stores, both of them mostly in the large cities, and of mail order houses, are typical in nature and volume of the sales of the miscellaneous retail stores scattered throughout the country. The

great volume of business done by department stores during last fall was largely due to a sustained campaign of bargain sales and constant advertising. For these shrewd merchants realized the conservative sentiment among the buying public, and went gunning for a trade that would not otherwise have come to them in such full measure. I know of instances of stores which did not adopt such vigorous measures and consequently failed of like success. The curve of sales of mail order houses often differs radically from that of other retail sales since it depends largely upon the seasons when the farmer has cash to spend, and these sales not infrequently represent a loss of such business to the retail trade in the small towns. There are not sufficient available figures of the many thousand individual retail dealers scattered all over the country, in small towns and large cities upon which to form statistical tabulations, but there is a great mass of information coming from the traveling salesmen to give substance to the statement that such sales were not in general conformity with those of the mail order houses, chain stores, and department stores.

Factors Affecting Present-Day Forecasts

During last fall consumers were everywhere slow to purchase and when they did, purchased only for immediate wants. Orders were generally for small quantities, and buying for the future was of most moderate nature. The reasons were obvious; the buying power of the cities was proportionally far greater than that of the country because of the great amount of building which was, and is, almost entirely in the cities. Likewise the manufacturing plants with their great numbers of wage-earners were also mostly situated in the cities. In the country the buying power was very limited in great stretches of wheat-raising sections, of cattle ranges in the west, and in scattered spots in the cotton belt. So if the total retail sales were available, the gradient of their curve would be much more modified than now shown. With these facts before me, and with the further addition of actual observation and of first-hand reports of the actual condition of business in every section of the country, I can only adopt the Missouri attitude of mind towards charts of distribution made up from statistics, some of them partial and incomplete, some of them mere estimates. Regarding these estimates I am often reminded of the calculations of a noted astronomer concerning the motion of Alpha cygni, a star which seems to be directly approaching us—"in a period which will fall somewhere between one-hundred thousand and three-hundred thousand years it will pass by our system within one-hundredth part of its present distance".

When it is remembered that the difference between the volume of business in good times and bad times is often only 10 per cent, it will be realized that estimates to be of any value must be fairly approximate, and we must have some idea as to how approximate they are. Here are two recent illustrations; the early government estimates of the cotton crop were about 12½ per cent too large, and yet for months these figures were accepted as the basis for all sorts of entertaining fiction such as the money the farmer would receive for his products last year, and the proportion of the value of the wheat crop to that of all these products. Meanwhile those who knew the facts, and stated them, were as the voice of one crying in the wilderness. Again for the past six months no one has had any intelligent idea as to how many hogs there are in the country, and estimates as to their number vary from 5 to 20 per cent in difference.

Public Sentiment as a Forecasting Factor

If we are to make forecasts of the future of business that are to be of real value, we must not only have more accurate and more complete statistics, but the prophets must also be in touch with the drift of public sentiment. It is today the controlling factor in the situation though there are practically but few statistics concerning it. Throughout the nation there is a general feeling of uncertainty and doubt regarding the future, and a consequent hesitation to embark in any ventures for the future and then only as necessity dictates. Buying by both consumer and dealers is largely from hand to mouth. This is true even in sections where fundamental conditions are inherently sound, which covers practically the greater part of the country in population if not in area. It is elementally a sound and healthy sentiment, born of the common sense of the many, and is our best safeguard against dangers of speculation and inflation. It is entirely unmoved by those specious prophecies of imminent prosperity which are common enough, and which seem merely intended to impart cheer and comfort to the situation, since the prophets must realize perfectly well that certain problems have to be cleared up before there can be any general and sustained forward movement. Those who seek to divine the future will find their best guide in the study of the nature and trend of this sentiment.

ARCHER WALL DOUGLAS.

Producing More Industrial Executives

Editors of MANAGEMENT AND ADMINISTRATION:

Just a few words on your editorial, "Producing More Industrial Executives," which appeared in the December issue of MANAGEMENT AND ADMINISTRATION. An editorial of this character interests me more than any other article because I am looking forward to the day I may become an industrial executive. I am a student of political economy and business administration at a university. I would like to present views of some young men who are supposed to represent the supply curve against those controlling factors represented by the demand curve.

It would be difficult to speak for the thousands who are attending universities preparing themselves for industrial executives or some other position in which they will be a benefit to society. There seems to be an ill feeling among the young men of today against industrial society.

The early part of this year I was forced to discontinue my classes at the university until I got a little money ahead. I have always worked my way through school. As I was studying economics I desired to get into industrial work.

I visited many industrial organizations of employment. When I started out, I believed that men of high degree and position were looking for young men who devoted a large part of their time and study to fill positions of importance in large industrial corporations. But no! Much to the contrary.

The one important factor I discovered and want to emphasize is that the young fellow who starts at the bottom as office boy, and just finished grammar school, is given the preference over university trained men. From experience, I found out that these men have no forethought, no practical knowledge of economics, know little about the business conditions and how to meet them, and if they were to speak the truth, they would admit they do not like to study. But yet, if there is a vacancy for a higher position this routine worker will get it through some influence or "pull" over the trained man. Why? Is not this a hindrance to society?

Let me cite you a case from my own personal experience. During my three weeks in quest of a position, I entered the employment offices of a world-wide corporation. After waiting in line for about an hour, I was interviewed by a man, a foreigner by birth and one who did not have an easy flowing English speech. He sized me up as if I was a dumb foreigner seeking a common laborer's job. I characterized him and readily saw that he was the type of person who would never give an intelligent American a good position. I expressed my desire in as few words as possible to give room for him to ask plenty of foolish questions. His questions were short of nature and I readily saw that he did not want to hire me. But I would not leave. I began to ask many questions which led me to the information that he had openings but desired kinfolk. He finally told me my education did not mean anything; I did not have enough experience. I thought that was hitting a university trained young man pretty hard. Education does not mean anything then? So, why urge colleges to train young men for industries?

I told him I wanted to see one of the executives. This put a scare into him and he gave me a position similar to that of an office boy. As I was anxious to get into any position, I took it with the thought of either developing the position or myself.

For almost two months I worked 10 hours a day, including Saturday and Sunday. One Saturday I wanted to get off and they told me to work or lose my job. I lost my job. I want it understood that the above hours were not agreed upon when I was hired.

I took my complaint to the superintendent—an "Industrial Executive". Such a discouraging talk I have never listened to. I found out that in this corporation all the executives had a very impressive "pull," also that all executives are always picked from the ranks.

This dissuasive person denounced education. In fact, he never would help a fellow who was in my position—making his way through school.

Do not believe I am pessimistic and trying to denounce the industrial executives, but there are a few things some executives must open their eyes to before they urge the young men of today to study for industrial executives.

I am writing this letter with only one thought in mind. After reading this letter what can you say to or for a young man, who, like myself, has spent almost two years of time studying at school and reading magazines on the industries of the world and its markets? Would you advise him to stop studying and consider the past as a waste of time or can you present new views to me on this subject? Don't think that the university trained man expects a million dollar position the day he leaves school, but he does expect industrial society and the commercial world to give him a fair chance.

Taking the facts I have stated, do you believe we are given that chance to prove ourselves? I am only one of the thousands. I can cite as many more cases of young men the same as myself.

I believe I have mentioned enough facts to prove to you that before the National Industrial Conference Board or any other committee starts a campaign to urge young men to train for industrial executives, they must first overcome the feeling most executives have toward university trained men. I speak from two years of "hard knock" experience.

It would satisfy me if some of the executives of society would read this and get the view of the young men of today—not only myself but those who think bravely and actively for the future. Yours very truly,

HARRY E. BELL.

Another Vote for Calendar Reform

DR. S. C. McLEOD, Secretary of the National Association of Cost Accountants, is receiving no little support of his brief for calendar simplification, published in this department in the December issue. Dr. McLeod firmly believes that there is in this country a great volume of interest in this question, if it could only be concentrated and brought to bear at the right point. Some years ago he operated a sales organization on 13 equal periods. He says that the plan made it easier for him to maintain his records, but created a considerable amount of confusion because the rest of the organization did not operate on the same plan. He believes that the scheme is feasible only as a general movement established by law, and probably on an international basis.

The letter which follows is from the Chief Engineer of the Rumford Falls Power Co., of Rumford, Maine:

Editors of MANAGEMENT AND ADMINISTRATION:

The communication of Dr. S. C. McLeod in the December issue of MANAGEMENT AND ADMINISTRATION has my full approval. I have been advocating calendar reform for a long time, and I began it by reforming the clock. In my management and records of continuous operations I have for more than 30 years used 24 hours a day instead of two twelves, with A. M. and P. M. This is, of course, the same system that is used on the railroads in France.

Pending the reform of the calendar I am smoothing part of the irregularities by putting the last day of January and the first day of March into February, so that the first four months have 30 days each.

CHARLES A. MIXER.

NEWS OF EQUIPMENT
FOR THE MANAGEMENT

This department is conducted to give the essential facts in regard to new equipment which may be used in the operation of manufacturing concerns. As the sources of the items are reputable manufacturers, MANAGEMENT AND ADMINISTRATION accepts this information as reliable. —THE EDITORS.

Pay-Roll and Production Accounting Machine

Index Number

651.264 Accounting machines

ONE of the significant developments in the past few years in industrial operation is the application of mechanical devices to do mental work. As a result more and more machines are being installed to perform calculations and accounting operations. The advantages which have followed the application of labor-saving devices to replace manual labor are being duplicated in this newer field, viz., increased production per unit of time, lower cost per operation, and lessened drudgery and fatigue of the worker. Machinery performs mental operations as well as manual.

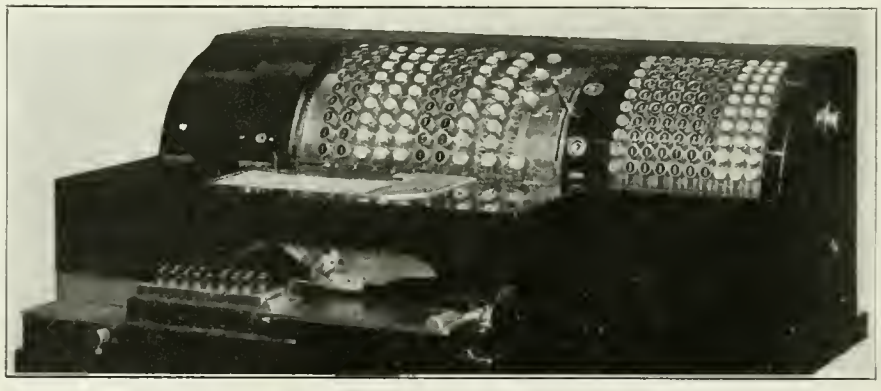


FIG. 1 A PAY-ROLL AND PRODUCTION ACCOUNTING MACHINE

Among these developments is one which has been in progress for some years in the plants of the National Cash Register Company and some of its customers. It is an accounting machine adapted to pay-roll and production accounting. It is of the selective card-posting type capable of giving 27 individual totals and three grand totals, and having a table which can register in any one of 26 lines on a record card or on two record cards. Furthermore it gives an impression of each posting on a continuous audit strip and will, when desired, give impressions of the totals, at the same time printing these totals on a separate record card. This machine is shown in Fig. 1.

The applications of this accounting machine are so fundamental and numerous in the developing of operating records that it is difficult to present them in a condensed space. However, by referring to the accompanying illustrations of typical cards and records it is possible to show how this machine has been adapted to pay-roll and production accounting.

Fig. 2 shows the pay-roll record side of the combined time and pay-roll card. The reverse of this card, which is not shown, is the regular Stromberg clock card, and is used to record elapsed time. The record on the side shown was printed in a machine of the type shown in Fig. 1. The first column shows the quantity of each lot of product; the second the price paid for that lot; the third the "total" of quantity; the fourth the "total" of price; the fifth the total quantity to date; the sixth, the total earnings to date; the seventh the symbol indicating the style; and the eighth and last, the number of the operator, the letter of the particular machine upon which the record was made, and the number of the style or kind of the article. All of this information is set up on the accounting machine, the card is inserted, being first registered to the line where the posting is to be done by means of the table shown at the extreme lower left of the machine in Fig. 1, when the tripping of the motor bar by the operator causes the record to be printed in its proper place on the card.

It will be noticed that the fifth column gives the total of the amount of product turned out, while the sixth column gives the total earnings for the period covered by the card. When the card is finished at the end of the week, the operator signs at the bottom under the statement—"If satisfied that all work for the week appears above—sign here," and signs again at the bottom when paid off. This card thus carries a complete production record for the operator, shows the earnings for the pay-roll period, and is a receipt for wages paid.

The girl who operates the machine has a table of products, of various quantities and piece rates, in order that the price set up for the second column of the card may be read without computation.

In addition to posting this information on the card an impression is made of every posting on a continuous audit strip. A section of this strip showing some of the entries on the card of Fig. 2 is reproduced in Fig. 3.

Furthermore the machine can accumulate totals for style or general order numbers and these may be printed on a card as desired at the same time being impressed upon the continuous strip. A record of totals is shown in Fig. 4. Printed on a card they are shown in Fig. 5.

No. 9998 WEEK ENDING

Name M.T. STITCHING

	Quan	Price	Pick Up	Pick Up	Total Dozen	Total Earn.	Symbol	Oper. Style
1	+33	1.34	+++0	*0.00	++33	**1.34	⊕	9998X700
2	+19	1.23	++33	*1.34	++52	**2.57	⊖	9964X1019
3	100	3.98	++52	*2.57	+152	**6.55	⊗	9998X7889
4	+25	2.79	+152	*6.55	+177	**9.34	⊘	9998X700
5	+33	2.79	+177	*9.34	+210	*12.13	⊙	9998X269
6	+31	2.47	+210	12.13	+241	*14.60	⊚	9998X7889
7	+67	4.09	+241	14.60	+308	*18.69	⊛	9998X6007
8	+33	2.93	+308	18.69	+341	*21.62	⊜	9998X 801
9	++0	9.99	+341	21.62	+341	*31.61	H	9998X3350
10								
11								
24								
25								
26								

Date Paid

Checked By

If satisfied that all work for the week appears above

Sign Here_____

Received from SMITH BROWN & CO., Inc. the final total appearing in the Total Earnings Column.

Sign Here _____

FIG. 2 PAY-ROLL RECORD SIDE OF THE TIME AND PAY-ROLL CARD

To indicate some of the uses made of this strip, let us assume that an error has been made in setting up the price corresponding to a given quantity of a certain lot of style. When the totals are printed the operator of the accounting machine can check the quantity against the price from her tables. In case she finds an error she can go back to the audit strip, pick out the individual entries for that particular style number, compare quantity and price, and thus discover the error. The individual item gives the number of the employee who did the work, and she can make the proper correction on the time and pay-roll card of the kind shown in Fig. 2.

Once this check has been made the entire pay-roll card has been subjected to a proof which is accepted as final and obviates any further checking of the time cards in the pay-roll department.

A use which has been made of the total figures as shown on the card of Fig. 5, is to post production records, inasmuch as the quantities and order or style number are shown. Daily postings from a record of this kind serve to provide the production department with a knowledge as to where all lots of material are and their condition, and the probable length of time required for completion ready for shipment. As a result it is possible to check the flow of production by classification or order number, to set up perpetual inventories and to check the amount of work paid for to piece operators by classification.

In the pay-roll department the operations of totaling, extending, and checking pay cards have been eliminated. In the audit department it is no longer necessary to check the quantity paid for at different rates and check again the total classifications payable at a given rate. These checks are now taken care of by the machine totals, as these totals are added by classification and also in dollars.

In one installation it has been found that one account machine can handle the records of 300 operators, and the girl handling the machine can easily make 150 entries per hour.

```
+33 1.34                          ⊕  9998X700
                  ++33 **1.34     —      X     Z
          +++0 *0.00              —P     X
+21 1.01                          ⊖  1241X2001
                  ++21 **1.01     —      X     Z
          ++33 *1.23              —P     X
+33 2.25                          ⊙  8906X1021
                  ++66 **3.48     —      X     Z
          ++55 *2.46              —P     X
+37 2.89                          ⊜  8900X 801
                  ++92 **5.35     —      X     Z
          ++11 *0.55              —P     X
+51 4.89                          ⊘  8800X7003
                  ++62 **5.44     —      X     Z
          ++35 *1.58              —P     X
+23 1.99                          ⊚  9964X6020
                  ++58 **3.57     —      X     Z
          ++33 *1.34              —P     X
+19 1.23                          ⊖  9964X1019
                  ++52 **2.57     —      X     Z
          ++21 *1.01              —P     X
+17 3.47                          ⊕  1241X700
                  ++38 **4.48     —      X     Z
          ++66 *3.48              —P     X
+78 3.68                          ⊛  8906X2001
                  +144 **7.16     —      X     Z
          ++52 *2.57              —P     X
100 3.98                          ⊗  9998X7889
                  +152 **6.55     —      X     Z
```

FIG. 3 CONTINUOUS AUDIT STRIP SHOWING SOME OF THE ENTRIES ON FIG. 2

```
+164 *12.92  ⊘   332 X7003X
++0 **0.00   ⊙       X     X
+280 *19.06  ⊚
+125 **8.09  ⊛   369 X6020X
++0 **0.00   ⊜       X     X
+154 *11.39  ⊖   106 X1019X
++0 **0.00   H       X     X
+151 *10.73  ⊕   123 X700 X
++0 **0.00   ⊗       X     X
+247 *15.83  ⊗   311 X6007X
+155 **9.13  ⊛   413 X2001X
++0 **0.00   ⊚       X     X
+193 *12.19  ⊙   223 X1021X
++0 **0.00   ⊘       X     X
+135 *11.49  ⊜   414 X 801X
++0 **0.00   ⊝       X     X
++0 **0.00   ⊖       X     X
+290 *15.98  ⊕   881 X7889X
++0 **0.00   ⊗       X     X
++0 *18.94   ⊛       X     X
```

FIG. 4 CONTINUOUS AUDIT STRIP SHOWING A RECORD OF TOTALS

One of the indirect features of the system which this machine makes possible is the personal check of the record by each responsible party before the report leaves his jurisdiction. This means that everyone knows where he stands and it is unnecessary for someone in another department to discover and call his attention to errors in pay-roll and production figures. As a result misunderstandings over wages and production have been eliminated.

One other feature of the machine is worthy of mention. If it is desired for any reason to print the same entry on two cards, this operation can be performed in one movement of the machine. The second card must be slightly larger than the first and a specimen is shown in Fig. 6. Both cards are inserted at the same time, the card of Fig. 2 being beneath and the card of Fig. 6 uppermost. The machine first prints the entry on the upper card, ejects it, and in the same downward motion of the impression mechanism prints the same record on the under card. The machine can be set at will to make either one impression on a single card or duplicate impressions on two cards.

If it is desired to file the second card under the same conditions as the first, it can be trimmed to the same dimensions.

This machine is known as Class-2000, Ledger Card Posting Register.

Z READINGS

CL401

	ADD	DEDUCT	DOZ.	DOL.	PRICE	STYLE
1			+164	*12.92	332 X	7003Z
2			+++0	**0.00		
3			+280	*19.06	369 X	6020Z
4			+125	**8.09	369 X	269 Z
5			+++0	**0.00		
6			+154	*11.39	106 X	1019Z
7			+++0	**0.00		
8			+151	*10.73	123 X	700 Z
9			+++0	**0.00		
10			+++0	*18.94	Hrs.	
11			+247	*15.83	311 X	6007Z
12			+155	* 9.13	413 X	2001Z
13			+++0	**0.00		
14			+193	*12.19	223 X	1021Z
15			+++0	**0.00		
16			+135	*11.48	414 X	801Z
17			+++0	**0.00		
18			+++0	**0.00		
19			+290	*15.98	881 X	7889Z
20						
					TOTAL	Z
					TOTAL	Re-Set
					TOTAL	Misc.
					TOTAL	Hour

GRAND TOTAL

Date_____ Signed_____

Dept._____

FIG. 5 CARD WITH TOTALS SHOWN IN FIG. 4

	Quan.	Price	Pick Up	Pick Up	Total Dozen	Total Earn.	Symbol	Oper. Style
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

FIG. 6 CARD USED WHEN A DUPLICATE OF FIG. 2 IS DESIRED

Four-wheel Drive Lift Truck

Index Number

658.281 Industrial trucks

TO build a lift truck having maximum freedom of action in traversing obstructions such as cobble-paved streets, railway crossings, and the like, the Terminal Engineering Company has developed a four-wheel drive machine. It is claimed that this construction, which has as its feature the absence of the small diameter pilot or trailer wheels, permits the truck to approach closer to the freight car, to the floor of which material is to be lifted or from which it is to be removed, with the truck standing at rail level.

The truck is built with varying heights of uprights for different requirements. In some cases the table can be dropped to a surface height of 5 in. from the floor. The table is 4 ft. long by 26 in. wide. Provision is made for changing the style of table in order that saddles with horns or double tangs or V-type tables may be inserted. The horn table is used for handling coiled rods or reels, car wheels, etc. The double tang

FIG. 1 FOUR-WHEEL DRIVE LIFT TRUCK

type is intended for handling tin plate, while other types are available for handling tote boxes, and a miscellaneous variety of work. The capacity on separable bodies for an evenly distributed load is:

Load in Pounds	*Size of Platform in Feet*
2100	6
2300	5
2600	4
3000	3

The hoist will raise a 3000 lb. load at the rate of 25 ft. per min., and will elevate empty at the speed of 50 ft. per min. An odometer is provided on one wheel to record mileage. A coupling device is provided when it is desired to use the truck as a tractor.

"Extralite" Spray Equipment

Index Number
669.6612 Spray painting

THE demand for a lightweight portable outfit of the pressure type for spray painting where areas to be covered are not extensive enough to warrant the use of larger painting plants, has led to the development of the "Extralite" equipment. This is small and light enough to be transported by automobile or other conveyance and can be handled by one man. It may be operated by attachment to the ordinary electric-light socket or can be furnished with a gasoline engine-driven air compressor.

This equipment is a new development of the Spray Engineering Company.

The total net weight of the complete outfit with attachments is 130 lb., motor driven; 135 lb. with engine-driven compressor. This equipment is particularly applicable for the interior painting of small industrial plants, offices, for use in automobile and other painting shops, for interior decorating, painting blinds and screens, bronzing radiators, and similar applications.

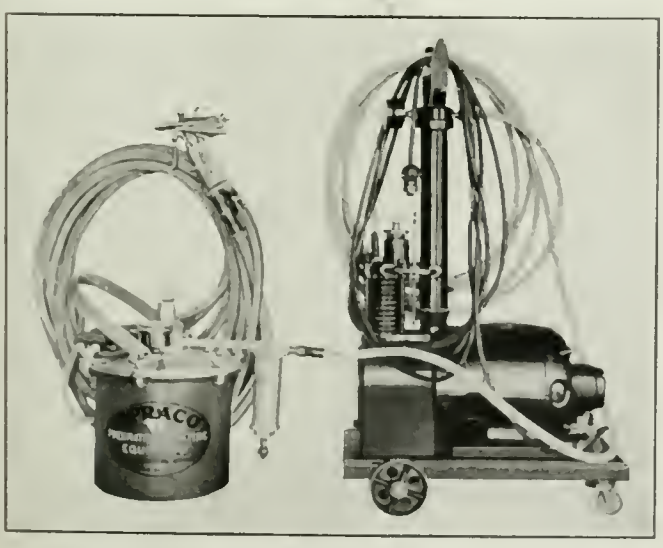


FIG. 1 "EXTRALITE" MOTOR-DRIVEN SPRAY PAINTING EQUIPMENT

Acid-Moisture Proof Fan

Index Number
621.63 Mechanical fans

TO resist the corrosive effects of acid and moisture, the Autovent Fan and Blower Company has developed a unit equipped with an aluminum frame motor fully enclosed. Its general features are shown in the illustration. It is adapted for ventilating or exhaust purposes

FIG. 1 ACID-MOISTURE PROOF FAN

in industrial plants where acid fumes or vapor are to be removed. Features of its construction are the use of corrosion-resisting materials and the enclosing of the fan motor in such a way that contaminating substances cannot reach the interior or working parts.

These fans are built in 16 in., 18 in., and 20 in. sizes.

Electric Type Temperature Controller

Index Number
662.612 Temperature controller

THE electric contact controller shown in the illustration consists essentially of a dial-indicating thermometer, the pointer of which is actuated by the usual mercury, vapor-tension, or gas-filled thermostatic system, depending on the desired range and other specifications. The bulb stem is inserted in the oven, furnace, tank, or other

apparatus where the temperature is to be controlled and is connected by a capillary tube to the case (8 in. in diameter) which can be mounted at any convenient location. As the temperature at the bulb increases or decreases, the thermostatic spring uncoils or recoils, thus moving the pointer across the scale. The exact temperature existing at the bulb is indicated on the dial and the responsiveness and closeness of the control may be determined.

The temperature is controlled by a simple arrangement. On each side of the indicating pointer is located an arm. These arms are mounted on the axis of the pointer and have mounted on them auxiliary contractor arms. By adjusting the left-hand arm to point to the minimum temperature, and the right-hand arm to point

FIG. 1 ELECTRIC TYPE TEMPERATURE CONTROLLER

to the maximum temperature, control is established between these two points in the following manner. When the indicating pointer reaches the minimum temperature, its contact block makes an electric contact with the left-hand arm, closing a circuit through binding posts L and C which operate through a relay to close the circuit of an electric heating coil. The current continues to pass through this heating coil until the indicating pointer reaches the maximum temperature and makes an electric contact, with the right-hand arm closing a circuit through binding posts C and H.

The least difference between minimum and maximum control temperatures is approximately 1/32 in. It cannot be expressed in degrees of temperature unless the range of the scale is known. The difference between the minimum and maximum temperatures may be changed by turning the adjustment screw provided within the case. This is accomplished by having the left contact arm moved toward or away from the right contact arm. The greatest difference between minimum and maximum control temperatures is approximately ½ of the total range. In addition, both arms may be simultaneously raised or lowered. Fluctuations in temperatures at the case of the instrument are corrected automatically.

The controller may also be used for starting and stopping a motor by means of a motor-starter, as in the case of an automatic refrigerating unit. It is manufactured by the C. J. Tagliabue Mfg. Co.

Indicating Steam Flow Meter

Index Number
621.171 Indicators

THE management of two classes of plants will be interested in the indicating steam flow meter described below. First, small plants using low capacity boilers of 100 hp. or less; and second, plants having a number of smaller boilers which are gradually being replaced by larger units. Neither plant can economically use an elaborate system of flow meters. They are, nevertheless, essential to provide the fireman with a record of operation to enable him to obtain a reasonable efficiency.

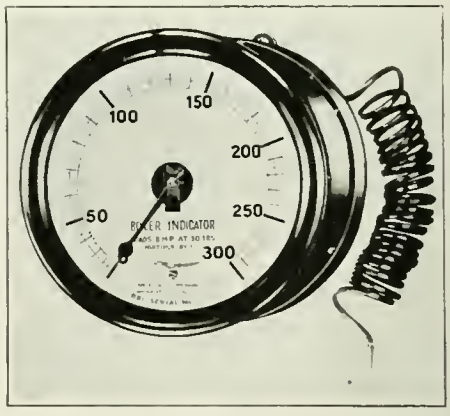


FIG. 1 STEAM FLOW METER

To meet the twofold need, the R. B. Meter illustrated herewith has been developed by the Republic Flow Meters Company. It is used to indicate to the fireman the load carried on each boiler.

In design the meter is a reduction to a smaller scale of the standard Republic R. S. Meter. It is therefore unnecessary to describe the design in detail. In general it consists of an indicating dial graduated to read

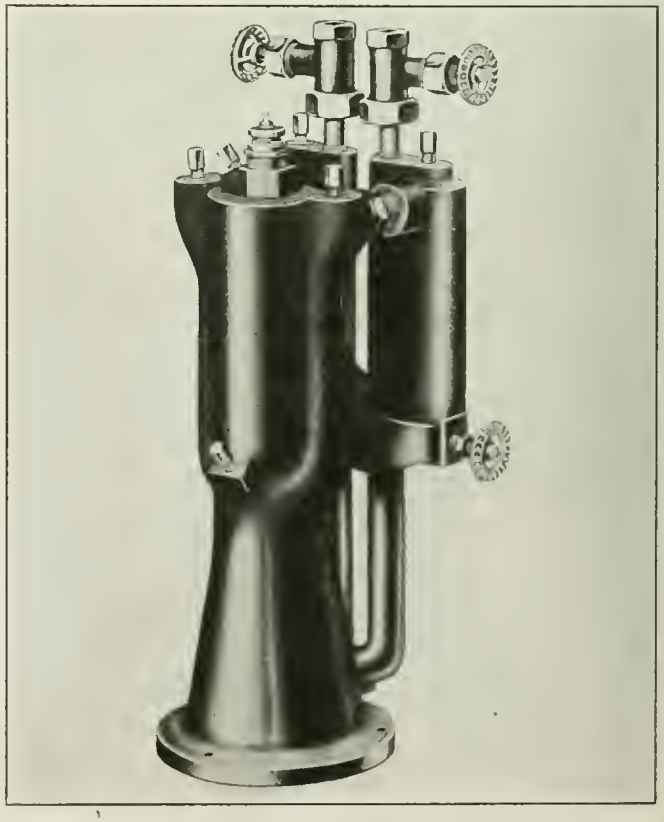


FIG. 2 FLOW METER BODY

directly to boiler horsepower, a meter body, and a differential medium—either a pilot tube or an orifice plate.

The indicator is installed on the boiler front and guides the fireman as to the demand on the boiler for steam. He is thus enabled to anticipate a sudden overload and increase the combustion rate in his furnace before the steam pressure drops. Likewise he is able to detect an impending drop in the load and can reduce his combustion rate to prevent waste of fuel. In these ways the meter is an instrument which aids in securing fuel economy.

Heavy Duty Elevating Truck

Index Number
658.281 Industrial trucks

THE demands of mass production require the movement of heavier loads through manufacturing processes, and to aid in the economical use of factory floor space. To meet this demand the Hi/Lo heavy duty elevating truck has been designed to handle loads up to 6000 lb. It is adapted to moving material in forge shops, foundries, and other departments where conditions are not always the best and where there is danger of the abuse of the product by unskilled labor.

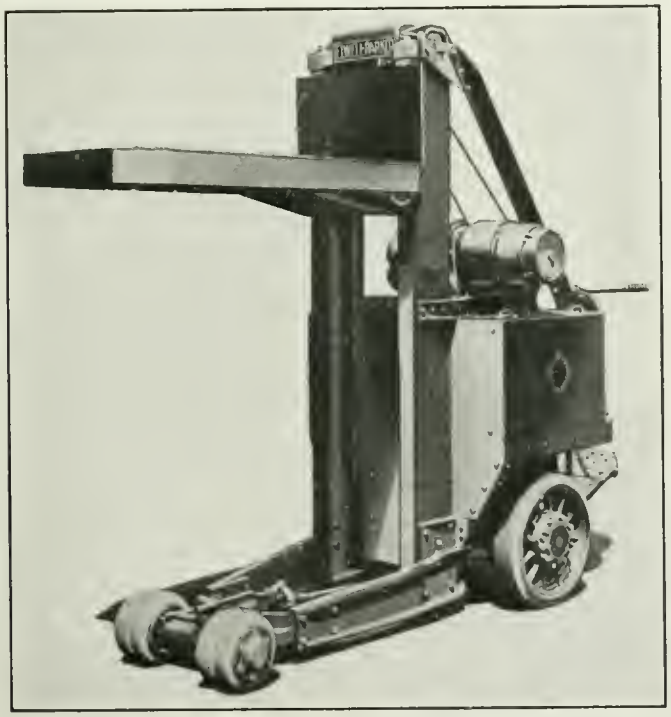


FIG. 1 HEAVY DUTY ELEVATING TRUCK

The machine is 112 in. long, 95 in. high and may be driven through a doorway 3 ft. 6 in. wide. It will pick up, transfer, and set down a loaded skid, will lift a load to any height up to 6 ft., and deposit it either on the floor or at any level up to 6 ft. above the floor.

The control of the truck is automatic, that is, the operator cannot move the truck except when standing on the pedals at the rear. The main switch can be closed and the power applied with the brake on, a method of operation necessary to secure safety in ramp operation. The switch closes only when the controller drum is in "off" position. If the operator steps off the truck all the electrical circuits are open and the brake is applied. The battery compartment will accommodate 30 cells of Edison type or 16 cells of lead. The truck with battery weighs 5200 lb., is capable of traveling at a speed of 300 to 400 ft. per min., and hoists at the speed of 5 to 6 ft. per min. The truck is manufactured by the Elwell-Parker Electric Company.

Fork Type Tier-Lift Truck

Index Number
658.281 Industrial trucks

THE demand for an elevating truck to handle such commodities as sheet tin in loading at the mill and in unloading and storing at the factory, has led to the development of the fork type machine illustrated herewith.

This machine can pick up loads of from 2000 to 2500 lb. which are stacked on 2 x 2 in. strips, and can save investment in skids. The tin is placed on these strips in the car at the mill and is unloaded by the same process at the plant where the tin is received. It is usual to stack tin in 2000 lb. units, three high. With an average travel of about 125 ft. one operator and his helper can unload a 35 to 40 ton car of tin in about 1¼ hr.

This machine, a new development of the Lakewood Engineering Company, can be used for other commodities which can be stacked on strips instead of in skids. The traveling and lifting mechanism of the truck is standard and the forged steel forks or arms can be arranged to meet the user's requirements. It is adapted to such commodities as flat paper, barrels, radiators, dies, etc.

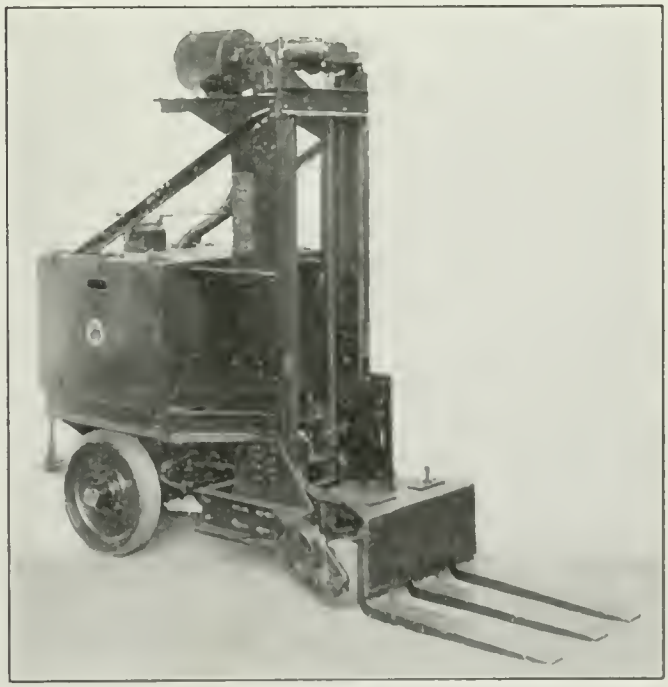


FIG. 1 FORK TYPE TIER-LIFT TRUCK

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 150 magazines; it also includes the publications of some 50 book publishers and professional societies as far as these are of managerial interest to industrial executives. The items are prepared and classified by the Engineering Societies Library in New York City. The decimal number at the right of each item is the index number and indicates the place the article or book will take when filed in accordance therewith in the classified subject scheme. If articles are grouped according to these numbers like subjects will automatically fall together and related subjects will follow in logical sequence. Photostat copies of any magazine article indexed can be supplied by The Ronald Press Company for a moderate charge. The books and pamphlets indexed can be procured from their respective publishers.

Accounting

657.524

Choosing the Basic Cost Plan. E. A. Camman. National Assn. of Cost Accountants. *Official Publications*, Nov. 1, 1923. v. 5, no. 4, 12 pp. Gives five types from which to choose a basic cost plan and describes each. Declares that five objectives must be held in view in applying any such plan; namely: Administration or Management control, Operating control, Cost control, Expense control and Cost of production.

657.5:791.4

Cost Accounting in the Production of Motion Pictures. By William R. Donaldson. 22 pp. National Association of Cost Accountants.

In view of the recent newspaper publicity on undesirable conditions in the financing of motion-picture concerns, this publication of the National Association of Cost Accountants is particularly timely. There are obvious difficulties in figuring costs in connection with motion-picture production. The real value lies mainly in the "idea" and the brain effort needed to crystallize it in photographed action. Large salaries are paid, but while the persons contributing the ideas and helping to work them out are present in the studio, presumably at work on a certain production, they may actually be busy formulating ideas for use in succeeding films. Thus it is very difficult to determine the actual cost of any particular picture. Mr. Donaldson presents an organization chart, showing a typical departmental and divisional arrangement of a large cinema enterprise; also a typical statement of cost items involved in the distribution of a picture, and a chart of asset and liability accounts. The author also explains the detailed charges to production in process, and offers a list of burden accounts, explaining the method of apportioning each burden item.

657.5244

Cost of Carrying Overdue Accounts. J. W. Hallman. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 63-64. "Accounts receivable" are a success or failure barometer of a business house. The author claims that to call on a delinquent customer will frequently result in the settlement of account, a continuance of business, and often new business. Other difficulties may be overcome by the "Shock absorbing account" method described by him in MANAGEMENT AND ADMINISTRATION for Oct. 1923.

657.524:658

Establishing Standard Cost. R. W. Darnell. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 51-56. Charts. The cost system should be the last part of the operating system installed in a factory. There are three systems—job, operation, and standard cost system. The first two of these are reviewed and the third carefully explained, including a comparison between the operation and the standard cost system.

657.524

General Accounting as Related to Production Control. Percy Stotenbur. Bulletin of the Taylor Society, Dec. 1923. v. 8, pp. 241-244. Begins with Merchandise Inventory and tells how the system described enables one to know the value of this account each month. Brings out the problems of inventory and shows that various kinds of stock have entirely different turnovers. A practical article, but one which cannot discuss the subject in great detail in so limited a space.

657.36

How to Read a Balance Sheet. *Iron and Coal Trades Review*, Dec. 14, 1923. v. 107, p. 894. Explains each of the following terms: Debentures—Sundry creditors—Reserves—Profits—Assets—Depreciation—Investments, and Cash in hand and at the bank.

657.524

Industrial Accounting Statistics and Their Interpretation. S. G. H. Fitch. National Association of Cost Accountants. *Official Publications*, Nov. 15, 1923. v. 5, no. 5. 14 pp. The primary factors governing the interpretation of all industrial accounting are the Balance Sheet and the Profit and Loss account. Takes up financial and operating ratios, the industrial budget, Co-ordination of statistics and accounts, and trade association statistics.

657.524
657.524 and 658.14

Industrial Cost Accounting for Executives. By Paul M. Atkins. 322 pp. McGraw-Hill Book Company.

In this volume Professor Atkins of the School of Commerce and Administration, University of Chicago, tells in straight-from-the-shoulder fashion how cost records are of value to an executive in the control of his business. While the title is limited by the words "for Executives," the usefulness of the book is not similarly inhibited. It is obviously important for executives to know what cost records should do for them, but it is fully as essential that cost accountants be told what the executives need in the way of cost information, and how it should be presented in order to be of the greatest possible value toward the establishment and maintenance of a really effective control. The book accomplishes both purposes. It begins with a survey of the uses of cost records and the methods to be employed in setting them up. Details of material cost, labor cost, expenses and burden are then outlined. A summary of the cost accounting process is presented, and the conclusion takes the form of an extensive consideration of the executive uses of cost records. The appendix contains an appraisal of the late F. W. Taylor's contribution to industrial cost accounting, a suggested method of using tabulating machines in connection with mnemonic symbols, and a bibliography of works in the field of cost accounting.

657.524

An Introduction to Predetermined Costs. George Rea. National Association of Cost Accountants. *Official Publications*, Dec. 15, 1923. v. 5, no. 7. 15 pp. The author has chosen a textile mill to illustrate the operations of a predetermined cost system, and aims to prove the system to be flexible enough to meet all the requirements of managerial control.

657.524:658

Is Our Investment in Cost Accounting Profitable? 5th article. T. W. Howard. In *Factory*, Dec. 1923. v. 31, pp. 760-761. "Where there is responsibility there should be accountability." The cost accountant must be in close touch with the profit and loss factors of the business as a whole and of main lines and departments. Mentions four main results that should come from cost work.

657.524

A Method of Costing Partially Completed Orders. C. B. Williams. National Association of Cost Accountants. *Official Publications*, Oct. 15, 1923.

v. 5, no. 3. 10 pp. Makes the point that the calendar month can be ignored in certain computations of production, but may be recognized for accounting purposes and book-keeping convenience. Methods of a plant manufacturing iron and aluminum cooking utensils are given as illustrating the system favored.

657.524

A Problem in Joint Costs. W. M. Cole. National Association of Cost Accountants. *Official Publications*, Oct. 1, 1923. v. 5, no. 2. 13 pp. Takes the sorting of apples as an illustration and works out methods of cost, analyzing them and pointing out the principle involved.

657.524

Standardization of Cost Finding Methods. *Welding Engineer*, Dec. 1923. v. 8, pp. 42, 44. Describes briefly the system employed in a welding shop. As the work progresses, the operator records on a shop record card all supplies and time used. These records are the basis for accurately determining the cost of a particular piece of work.

657.524

The Story Told by the Financial and Operating Statements. J. H. Bliss. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 25-30. Of the usual financial statements probably not one in a thousand tells the full story. A typical report is taken and analyzed for the purpose of showing the wide range of essential information that can be drawn from its figures.

657.5:658.8

What Does Your Selling Expense Include? W. R. Basset. *Advertising Fortnightly*, Jan. 2, 1924. p. 14. How much of the selling cost should be charged to manufacturing. If an activity helps to sell the product, or if the sales department by selling in distant territory entails an extra expense, the cost is a selling cost; but if the manufacturing is benefited, it is a manufacturing cost.

Advertising

659.1

The Bureau of Standards as a Source of Copy and Sales Ideas. James True. *Printers' Ink Monthly*, Jan. 1924. v. 8, pp. 46, 48, 50. Invites attention to the facts which may be culled from the publications of the Bureau and the weight which such a backing gives to the advertising use of these facts. The Bureau makes tests of manufactured products for individual manufacturers at a nominal cost. The results of these tests often give splendid advertising ammunition.

659.1

Glass Pockets in Business. D. E. Wheeler. *Printers' Ink Monthly*, Jan. 1924. v. 8, pp. 52, 55, 56. Advocates the idea that spreading the news about your business is one of the best mediums of advertising. Let the public know your problems, efforts and accomplishments and so win their confidence. Author recounts the opinions of many prominent business men on this subject of giving transparency to the conduct of modern business.

659.1

"Half-Baked" Media Analysis. R. B. Donnelly. *Advertising Fortnightly*, Dec. 19, 1923. v. 2, pp. 13, 36-38. The business man of the future will make more money by reducing prices than the business man of the past ever made by raising prices. Advertising as a means of standardizing a product in the minds of the public will create market and help to cut cost.

659.1

Package Inserts—Versatile Allies of Your Advertising. C. B. Larrabee. *Printers' Ink Monthly*, Dec. 1923. v. 7, pp. 31-33. Illus. Various methods used and the results gained. One of the widest uses of inserts is cross-packing, or the packing of an insert of one line in with other products of the line.

659.1

Picking a Sales and Advertising Policy That Will Last. Henry Burwen. *Printers' Ink*, Jan. 3, 1924. v. 126, pp. 10, 12. Demonstrated how a larger volume of business was secured by specializing on a single type of product. A manufacturer of radio apparatus takes transformers as his leader and uses the slogan "Acme for Amplification" in his advertising campaign.

659.1

Putting the Spirit of 1924 Into the Product of 1889. Ray Giles. *Printers' Ink*, Dec. 27, 1923. v. 125, pp. 3-6, 138. How advertising can meet the ever increasing demand for something new. Keep the spirit of youth in the business, adopt new methods of expressing old ideas and find new applications for old products. Better to vary the advertisement of a product than the product itself.

659.1

Relating Advertising to the Financing of a Business. R. R. Updegraff. *Advertising Fortnightly*, Dec. 19, 1923. v. 2, pp. 15-16, 44. The author aims to prove, by the use of three graphic charts, how a circulation statistical chart of a publication can present juggled figures misleading to the buyer of advertising space even though the figures remain mathematically correct.

659.1

The Science of Marketing by Mail. Homer J. Buckley. *Forbes*, Dec. 8, 1923. v. 13, pp. 271-272, 281. Salesmen waste time in going after men who are not real prospects, and in not being able to answer questions. To eliminate this waste and bring about more contentment among salesmen a regular system of mail advertising should be carried on. Gives many illustrations indicating that the mail method of advertising is a sure way of cutting sales costs.

Buildings and Power Production

658.26

Draft Control for Cutting Down Boiler Losses. Robert June. *Gas Age Record*, Dec. 22, 1923. v. 52, pp. 763-5. Draft regulation one of the most important factors in maintaining combustion efficiency. There is one best draft for each boiler with a given fuel and a given rate of combustion. This best draft can be readily determined by experiment. Chart gives a good idea of the draft required to burn a number of the most commonly used steam coals at various rates of combustion.

658.25

Gas the Ultimate Fuel for Industry. H. O. Loebell. *American Gas Journal*, Dec. 29, 1923. v. 119, pp. 673-75, 84. Two basic considerations discussed: scientific factors involving effective utilization of the fuel for industrial heating, and the economic factor involving present cost of fuel and future lower rates. Central station considered as the ultimate solution for community supply, and development of more efficient gas furnaces to mark future progress.

658.26

Power Problems of Vital Interest to Executives: VIII—The Prevention of Boiler Room Losses. J. T. Beard. *Industrial Management* (N. Y.) Dec. 1923. v. 66, pp. 355-360. Illus. How to derive a common basis for determining boiler plant efficiency from the viewpoint of "debits and credits." Emphasizes the study and control of heat losses.

658.242

Revamping an Obsolete Lighting System. J. J. McLaughlin. *Industrial Engineer*, Dec. 1923. v. 81, no. 12, pp. 571-74. An efficient lighting system, which provides a comparatively uniform illumination over the entire room, tends to increase contentment among workmen and to reduce accidents. Recommends the use of gas-filled Mazda lamps.

695

Roof Types and Surfaces for Industrial Buildings. W. F. Ballinger. *Engineering and Contracting—Buildings*, Dec. 1923. v. 60, pp. 1331-38. Covers different types of roofing, giving characteristics of materials and methods of building, so one may know which to use in a special type of plant.

658.26

What Does the Super Power Plan Mean to You? Guy E. Tripp. *Industrial Management* (N. Y.) Dec. 1923. v. 66, pp. 345-346. This question which has heretofore been considered in its national aspect is here narrowed down to the individual manufacturing plant to see what the super-power plan will do for production costs and for the individual consumer.

Economics

331.3

Child Labor and the Constitution. By Raymond G. Fuller. 323 pp. Thomas Y. Crowell Company.

The author of this sane and timely

discussion of the child labor problem is Executive Director of the Trounstine Foundation for Social Research, and was formerly closely associated with Dr. Owen R. Lovejoy in the work of the National Child Labor Committee. One of the achievements of Mr. Fuller is the building of an admirable slogan for the whole child labor reform movement. "Not an unoccupied childhood," he says, "but a well occupied childhood is the aim of child labor reform". The book has two objectives—to give a complete resume of the question of child labor, past and present, and to present a digest of all legislation on the subject. After an introductory chapter on "The Children of America," Mr. Fuller discusses rural child labor, and the problem from the point of view of the city, of industry and of education. Chapter V deals with laws and legislative standards, Chapter VI with "The Problem of Federal Action," and the concluding chapter with "International Legislation". This is a careful, well-balanced study of a difficult social problem, by a writer who has had exceptional opportunities for intensive study and observation.

332.1

Commercial Banking—Principles and Practice. By William H. Kniffin. 808 pp. (2 volumes). McGraw-Hill Book Company, Inc.

These volumes reflect the experience of the author in more than 30 years of bank work, and 10 years as a writer and lecturer on banking subjects. The length of "Commercial Banking" is offset to a considerable extent by the arrangement of the material. The theory of money and the development of banking in the United States are presented in order to form a ground work for an understanding of the practical work of a bank. Those who wish to study banking practice only, may omit the opening chapters and still have a complete picture of a bank by beginning with Chapter VII. Those desiring to study only the theory of banking and a resume of the history of banking in this country will find it in the first six chapters. The author, who has to his credit also two well-known banking books, "The Business Man and his Bank," and "American Banking Practice," has covered in the two volumes of the present work all departments of commercial banking except the foreign exchange and trust departments.

338:665

Co-ordination of Production with Sales for Oil Companies. E. G. Reynolds. MANAGEMENT AND ADMINISTRATION, Jan. 1924, v. 7, pp. 85-89. Charts. The purpose of a method for the co-ordination of production and sales in integrated oil companies, is to establish a program which will enable distant planning, provide a basis for predetermined consumption and surplus production, and be a guide in disposing of the surplus product of the refinery to greater advantage.

330

The Economics of Overhead Costs. By J. Maurice Clark. 502 pp. The University of Chicago Press.

This is the latest addition to the University of Chicago series, "Materials for the Study of Business". Professor Clark describes his volume as "a bit of research into the principles of dynamic economics". In referring to it as "a bit," he is entirely too modest. At first thought it seems doubtful whether a book which is essentially experimental research in economic theory properly belongs in a series entitled "Materials for the Study of Business". But the author explains that he believes in carrying theoretical study into the realm of those facts and forces with which business is consciously in contact; and that the editors of the series hold that a study of the laws of industry from the broadest social viewpoint, and from the viewpoint of the search for useful truth of whatever color, is a vitally necessary part of business education. Unused capacity is the central theme of the book. It studies the discrepancies between supply and demand. In fact the book is really a study of the discrepancies between an ever fluctuating demand and a relatively inelastic supply of productive capacity, resulting in wastes of partial idleness and many other economic disturbances.

330

The Foundations of National Industrial Efficiency. By Vandeveer Custis. 324 pp. The Macmillan Company.

Here is another volume bearing the much knocked-about word "efficiency" in its title. However, the author, who is associate professor of economics at Northwestern University, gets off on the right foot by admitting that although the term "efficiency" is much used in business and economics, it has no clear, generally accepted meaning. Professor Custis evidently started out with the idea of making a specialized study of the efficiency (there we go again!) of our great industrial organizations, and found it a tough job. He then shifted his objective, and concentrated on the analysis of the nature of industrial efficiency, its significance, and some of the most important conditions on which it depends. He offers his results frankly as "starting points of many different aspects of the general subject". Viewed in that light, it is valuable, workmanlike material. It covers labor, land, capital and management, and studies the effect of such factors as war, immigration and monopoly. Particularly timely is Professor Custis' discussion of the proper education and utilization of labor, the need and the methods of conserving our national resources, and the necessity for encouraging thrift.

656.235

Freight Rates and Charges. By Harry C. Barnes. 314 pp. Traffic Law Service Corporation.

Simplifying difficult rate problems, this book renders an important service to many men, including business executives, railroad officials, traffic managers, claim agents, and all who have responsibility for the details of shipping. It presents the laws, rules and regulations governing the construction, operation and development of railroad freight rates and charges in their application to interstate and foreign commerce. It covers a wide range of subjects involving the legal status of different kinds of rates; their establishment, assessment, quotation and maintenance. It also indicates with admirable clearness the jurisdiction of the Interstate Commerce Commission. The volume contains a comprehensive analysis of existing freight rates, with copious notes and more than 1500 authority citations, a detailed index and table of cases. It is printed on good paper, in large type, and differs from ordinary publications in that the analysis, subject matter, index and case sections are printed on papers of varying shades, which is a distinct aid to quick reference.

331.89

The Futility of Lockouts and Strikes. Paul Ogilvie. *Bulletin of the Taylor Society*, Dec. 1923. v. 8, pp. 219-224. Some of the most pronounced struggles in Great Britain are given in this scholarly study. The author takes up the questions involved in each strike and gives figures and facts to prove that results were in most cases negative. History seems to prove the futility of the system.

656.24

Limitation of Common Carriers' Liability. By Harry C. Barnes. 366 pp. Traffic Law Service Corporation.

The purpose of this volume, which is uniform in general makeup with "Freight Rates and Charges," is to state the present law governing carriers' liability. It covers the filing and settlement of claims against common carriers for loss, damage, injury and delay to property transported in interstate and foreign commerce. The book deals with all the principal questions involved in claims between shippers and carriers, including the status of carriers' liability and the validity of limited-liability clauses in bills of lading under Section 20 of the Interstate Commerce Act, as developed by the "Carmack Amendment" and the first and second "Cummins Amendments". Many leading decisions of the United States Supreme Court governing this subject are treated, including such well-known control cases as those of the Neiman-Marcus Co., McCaull-Dinsmore Co., Primrose, Lockwood, Blish Milling Co., etc. As in the case of "Freight Rates and Charges," a color scheme is used in the printing. For purpose of quick reference, the analysis section is printed on pink paper, subject matter on white, index on green and table of cases on yellow.

511.8

Mathematical Principles of Finance. By Frederick C. Kent. 253 pp. Mc-

Graw-Hill Book Company, Inc.

The author is Associate Professor of Mathematics at the Oregon State Agricultural College. In this volume he deals with the mathematics of investment and insurance, discussing the logarithmic solution of compound interest problems, the computation of annuities, amortization, valuation of securities, series and their applications to interest, and the calculation of net premiums and reserves. Comprehensive tables covering the compound interest functions are included. The fundamental principles of the theory of interest and annuities have been developed in a manner that will be easily understood. In the earlier chapters of the book all formulas are developed from concrete examples, and followed by numerous illustrative solutions of type problems. Applications of the theory of interest are made to the amortization of interest-bearing debts; the valuation of bonds and other securities; and the depreciation of assets, loans and investments of banks operating under the supervision of the Federal Farm Land Board. Special features of the book which add to its value to the accountant or business executive are the simple methods employed in the derivation of interest and annuity formulas, and the reductions of annuity formulas for nominal rates of interest so as to obtain directly from tables the solutions for many problems which would otherwise require a logarithmic solution.

311:38

A New Index of the Volume of Trade. Carl Snyder. *Journal of the American Statistical Association,* Dec. 1923. v. 18, pp. 949-963. A system of estimating the percentages of variation in the total volume of industry and trade of the country, in relation to a computed "normal rate of growth." The author chooses 28 representative series, as producers' and consumers' goods, car loadings, retail sales, postal receipts, electric power production, etc. Discusses such problems as weighting (relative values) concept of normal, seasonal changes and influence of price changes. Gives charts.

332.1

Picking Out Your Bank. H. P. Willis. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 73-77. A general discourse on banks and banking, covering: Location of bank, Specialized bank, The service function, Finance companies, Local trade, and Competition. From the viewpoint of the relation of banks to the business man.

311:38

The Present Status of Statistical Research in the Administration of Business. C. L. Sweeting and D. K. Pfeffer. *Bulletin of the Taylor Society,* Dec. 1923. v. 8, pp. 215-218. A questionnaire was used to ascertain the extent to which precise statistical procedures are being used as aids in the stabilization of business.

Results seem to show that Scientific management has come to include the study and interpretation of statistical evidence. The table, giving analysis of replies, covers: Production, Marketing, Finance and Administration (Plant Expansion).

Financial Control

658.14

Budgeting a Business to Make It Pay. George E. Boynton. *System.* Jan. 1924. v. 45, pp. 46-49. How the author worked out his own budget plan. Every department is budgeted, taking into account conditions as to sales prospects, inventories on hand and expected accomplishments for the year. This planning furnishes figures which allow the firm to maintain a financial balance.

658.14

The Compilation of a Budget. T. B. Fordham and E. H. Tingley. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 57-62. A careful analysis of procedure to determine a business working budget. Budget requirements are: 1—planning for future, 2—execution of plan, 3—checking of results; these operations are required of the manager, department heads, and the comptroller. How these must cooperate to bring about effective results is comprehensively presented.

658.14

Industrial Accounting Statistics and Their Interpretation. S. G. H. Fitch. National Association of Cost Accountants. *Official Publications,* Nov. 15, 1923. v. 5, no. 5. 14 pp. The primary factors governing the interpretation of all industrial accounting are the Balance sheet and the Profit and Loss account. Takes up Financial and operating ratios, the Industrial budget, Coordination of Statistics and accounts, and Trade association statistics.

658.14

Mobilization of Cash Reserves. A. H. Swayne. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 21-23. Illus. How the General Motors Corp. devised an internal financial reservoir that reduced its unproductive capital, yet made available greater sums to units temporarily in need of aid. The system is like that of the Federal Reserve Banks which is utilized as part of the scheme.

658.14

The Story Told by the Financial and Operating Statements. J. H. Bliss. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 25-30. Of the usual financial statements probably not one in a thousand tells the full story. A typical report is taken and analyzed for the purpose of showing the wide range of essential information that can be drawn from its figures.

Industrial Accidents

658.283

The Essentials of Safeguarding. A. D. Risteen. *Universal Engineer,* Dec. 1923. v. 38, pp. 30-32. Shows the need for studying every part of a plant in order to determine the necessary safeguards. Notes the requirements of law, of codes, and of insurance companies. Emphasizes the need for safeguards in connection with the generation and distribution of power.

614.831

Powdered Coal Hazards. H. G. Jacobsen. *Cement, Mill and Quarry,* Dec. 5, 1923. v. 23, pp. 29-30. Emphasizes safety measures to be taken in the handling of coal dust in cement plants. Includes suggestions for the plan, care and operation of the coal mill. Article is an abstract of paper read at Annual Safety Congress, 1923.

Industrial Research

6(072)

Extreme Variety Versus Standardization: II—Research at the General Electric Company and Its Effects on Variety. L. A. Hawkins. *Industrial Management* (N. Y.) Dec. 1923. v. 66, pp. 327-334. Illus. Emphasizes the difference between the research laboratory and the industrial laboratory. Surveys briefly the progress made in the field of scientific electricity from the discovery of the electron to radio broadcasting. Describes the main research laboratory at Schenectady and its equipment, and tells of some recent discoveries.

6(072)

Industrial Research a Factor in Progress. A. W. Mellon. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 17-19. The author, present Secretary of the Treasury, believes industrial research to be the great gift of science to manufacturing. Special emphasis is made to the contributions the chemist has made to technology, especially the iron and steel industry. Makes mention of noted discoveries and describes the fellowship system in operation since 1911 in the University of Pittsburgh, where the Mellon Institute is located.

Industries—Special

658.9:621.7

L'Application de la Methode Taylor, R. H. Bender. *Le Genie Civil,* Nov. 17, 1923. v. 83, pp. 491-95. A detailed account of the use of the Taylor system, and of the Rowan system of premiums, in the machine building plant of Faure Et Cie at Limoges.

658.9:621.72

The Foundry and Its Manager. Leon Thomas. *Foundry Trade Journal,* Dec. 6, 1923. v. 28, pp. 472-73. Qualifications essential to a foundry manager. He should know how to calculate weights of castings, to decide on the method of moulding, to estimate the time needed to complete the job, etc. He must have the ability to control men.

658.9:629.113

Mobilization of Cash Reserves. A. H. Swayne. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 21-23.

Illus. How the General Motors Corp. devised an internal financial reservoir that reduced its unproductive capital, yet made available greater sums to units temporarily in need of aid. The system is like that of the Federal Reserve Banks which is utilized as part of the scheme.

658.9:622.33

Power Costs in Coal Mining. E. B. Stavely. *Coal Industry,* Dec. 1923, v. 6, pp. 496-499. Illus. Takes up under specific headings the factors which must be considered in figuring cost of power at coal mine. Makes a comparison between costs and power purchased from Central Station and that generated by a plant at the mine. Items are grouped under Fixed charges, which include: Interest, Depreciation, Obsolescence, Taxation and Insurance and under Operating charges which include: Labor, Supplies, Maintenance and Miscellaneous expenses.

658.9:625.2

Production Methods in British Passenger Car Building. D. R. Lamb, *Railway Review.* Dec. 1, 1923. v. 73, pp. 782-786. Illustrated. Modern efficiency methods applied in the manufacture of wooden passenger cars. Discusses machinery of parts, the assembly of each part in quantity to be drawn on as required ("unit assembly") side framing, roofs, framework, erection of the coaches, and interior furnishing.

658.9:631.71

That Repair Order! H. S. Riggs. *American Machinist,* Dec. 27, 1923. v. 59, pp. 933-938. Management methods used in a shop whose sole business is to get out quick repair work. Discusses clerical details, ordering castings, routing the order, keeping the order moving, and inspection.

658.9:621.13

Shop Scheduling and Production Control. L. C. Bowes. *Railway Review,* Dec. 29, 1923. v. 73, pp. 925-29. Describes the organization for production control in a locomotive shop. Emphasizes the help gained from analysis and perfection of the details of operation.

Management

658(42)

The Art of Management. Oliver Sheldon. *Bulletin of the Taylor Society,* Dec. 1923. v. 8, pp. 209-214. Gives a clear and comprehensive comparison between the status of Management in England and America. The British point of view is conservative, but open-minded. Shows what progress has been made in England and what organizations are contributing to industrial administration. Believes the British lack a corporate feeling as well as the literature of management which forms a practical link between readers. With these lacks supplied, the art (not the science) will achieve a professional status in Great Britain.

658.16

The Compilation of a Budget. T. B. Fordham and E. H. Tingley. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 57-62. A careful analysis of procedure to determine a business working budget. Budget requirements are: 1—planning for future, 2—execution of plan, 3—checking of results; these operations are required of the manager, department heads, and the comptroller. How these must cooperate to bring about effective results is comprehensively presented.

658

I Stress Methods—Results Naturally Follow. B. A. Franklin. *Factory,* Dec. 1923. v. 31, pp. 741-744, 772. Executives should feel the pulse of the whole business and be so conversant with methods as to be able to suggest improvements all along the line. Tells of some improvements in management in the paper industry and enumerates reports which determine whether the plant is living up to standards set.

658

Idle Capital in the Machine Shop. III. A. Easthope. *Industrial Management* (London), Nov. 29, 1923. v. 10 n. s., pp. 300-302. The author has deviated somewhat from his subject, and devotes this, the third article in the series, to a plea for the correct understanding of management and the need for proper direction backed by a sound understanding of economics and psychology. An "Idle Machine time chart" is the only contribution the article makes to machine shop practice.

658

Increasing Human Efficiency in Business. By Walter Dill Scott. 364 pp. The Macmillan Company.

This is a new edition of a popular book, by the author of "The Theory of Advertising", "The Psychology of Advertising", "The Psychology of Public Speaking," and "Influencing Men in Business". With its added chapter on "Personnel in Industry," this volume is unquestionably a significant contribution to the literature of business psychology. Professor Scott discusses the various means of increasing human efficiency, considering in successive chapters imitation, competition, loyalty, concentration, wages and pleasure. One of the best chapters is the one on Relaxation, which is headed by the familiar words: "Be not therefore anxious for the morrow". Professor Scott says that "men noted for efficiency almost never appear to be hurried"; that there is, in middle class American society, a marked lack of repose; that worry exhausts more than labor; and that every business man should have an outside interest so absorbing that when he is engaged with it, business is entirely banished from his mind. Dun's Review has characterized this interesting and useful book in a single sentence: "It is calculated to make the reader think and act for himself, and no book can do better than that".

658

Modern Management and Its Influence on Industry. C. J. Knoeppel. *Society of Industrial Engineers Bulletin,* Nov. 1923. v. 5, pp. 4-6. Aims to point out some of the shortcomings of management. More attention has been given to production than to other things with the result that management has done more for labor than for capital. Contends that simplification is needed and that more stimulus should be given to trade associations in making surveys of industries. Gives as the most important single factor in promoting management, the proper and legitimate exchange of cost data.

658

Planning for the Business You Are Going to Have. Milton S. Florsheim. *System,* Jan. 1924. v. 45, pp. 30-32, 78. Standards make a better foundation for a permanent future than immediate profits. Working on this basis, the Florsheim Shoe Company gave its best efforts to improving the product, strengthening the organization, making friends, and winning the confidence of customers. The article shows how a business may be developed on sound policies.

658.16

The Rise of "Industrial Democracy": VII—The Organization of Modern Industry. D. S. Kimball, MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 45-49. Defines and describes industrial democracy as the idea has developed and been known as Co-operative ownership, works council, joint committees, etc. Industrial democracy is based on the same principles as representative government. The author points out some of the defects and difficulties but feels it holds a principle that is worthy of careful consideration.

Mechanical Handling

658.2813

Gravity Conveyors in the Machine Shop. M. W. Potts. *Machinery,* Jan. 1924. v. 30, pp. 331-337. The advantages, to the smaller machine shops, derived from an intelligent installation of the gravity conveyor. Covers design of bearings for gravity rollers, types of rollers, guards and curves, switches and supports, conveyor grade, and where the conveyors should be installed.

658.281:662.65

Industrial Coal-Handling Equipment. G. E. Titcomb. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 79-84. Illus. Considers equipment applicable to the individual industrial plant only. This includes the crawler tread locomotive crane, the standard gage crane, the traveling bridge for large scale coal handling, loading from storage into trucks and the clam shell bucket. Approximate calculations for operation costs are given for the standard gage, the broad gage, the traveling bridge crane.

658.281

Materials Handling in the Warehouse. M. W. Potts. *Industrial Management* (N. Y.) Dec. 1923. v. 66, pp.

337-343. Illus. Materials handling equipment that will decrease floor space and labor costs in warehouses. Discusses high piling, tiers, racks, overhead cranes, monorails, etc.

658.281:662.65

Power Plant Compactness—Economy. *Black Diamond*, Dec. 22, 1923. v. 71, pp. 756-7. Illus. Describes coal handling systems of the Olds Motor Works as one of the chief factors in keeping down the cost of operating power plant, thereby playing an important part in the production cost. Gives detail of operation, and distinctive features of system. The entire structure, bunker and elevator, is one unit and is made of reinforced concrete.

658.281

Salvaging Scrap in Cadillac Plant. *Iron Age*, Dec. 13, 1923. v. 112, pp. 1571-1574. Illus. Instead of allowing scrap to accumulate in the manufacturing departments, this automobile company has erected a separate building equipped for breaking up and mechanically handling long turnings. The ouput, which averages 15 tons a day, is immediately transferred to this building. Describes the method of handling and treating.

One of the interesting features is the recovery of oil.

Personnel

658.3

The Calculation of Labor Turnover. Special report of the Committee on Management Terminology of American Management Association. 1923. *Pamphlet*. 16 pp. An effort to arrive at a standardization of present accepted practice. Suggestive rather than conclusive.

658.3

Car Repair Contest. Delaware & Hudson Co. *Railway Review*, Dec. 22, 1923. v. 73, pp. 891-894. Account of a contest between five teams of car repair forces, in removing and rebuilding the entire woodwork of a composite twin hopper car of 85,000 lb. capacity. Promoted to show the merits of system and cooperation and the results of the piece work plan of compensation.

658.3

Conferring with Employees. Report of Committee on Employee Co-operation of American Management Association with Convention Discussion. 1923. *Pamphlet*. 17 pp. Gives eight principles upon which cooperative plans should be built. The discussion brings out some valuable comments of the members of the committee of which Mr. Oscar Miller was Chairman.

658.3

Dividing Profits with Employees. C. P. Bentley. *Michigan Manufacturer*, Dec. 8, 1923. v. 32, pp. 1, 26. How a profit-sharing bonus plan reduced labor turnover and was a drawing card in the return in the fall of the skilled machine operators who were laid off during June and July because of shut-down. This same company gives each employe a life insurance policy.

658.3

An Employees' Suggestion Contest that Helps Iron Out Operation Details. J. V. Long. *Printers' Ink*, Dec. 27, 1923. v. 125, pp. 73-74, 76. Prizes are offered for each usable suggestion and a committee acts as judge. Each suggestion is referred to the department directly interested in that particular phase of the company's work. The employees' magazine is used to announce the names of the winners.

658.3

The Field of Personal Administration. Ordway Tead. *Bulletin of the Taylor Society*, Dec. 1923. v. 8, pp. 237-240. The author sees the personal problem not solely as industrial, but as *organizational*. The work should be delegated to equipped executives with adequate authority.

Points out the training needed for Personnel managers and shows the opportunities open to such trained men.

658.3

Here's a Book for You to Read. George W. Gray. *Business*, Jan. 1924. v. 5, pp. 13, 38-39. Employees of the Southern Bell Telephone Company have free use of books and reading courses which give them an opportunity to qualify for better work. List of books is kept small so selection may be quickly and easily made and not confuse the men. No test or examination is involved. The service is offered at a minimum cost to the company.

658.3

High Cost of Unproductive Time in Plant Operation. E. S. Hanson. *Cement, Mill and Quarry*, Dec. 5, 1923. v. 23, pp. 31-32. Methods of an eastern producer of sand and gravel in making an accurate record of the time lost at his plant during the season, and the resultant loss in dollars and cents. Includes two diagrams giving the classification of delays and their cost. Figure arrived at to cover all charges of operation was 50 cts. per minute and this figure was used in computing the cost of lost time.

658.3

Housing Workmen at Krupp Mines and Works. Hubert Hermanns. *Coal Industry*, Dec. 1923. v. 6, pp. 508-11. Illus. A very definite description of the arrangement of the dwellings and their surroundings. Houses are let to the workers and cannot be owned by them, but the rents are considerably lower than those prevailing in the town. Before the war the return in rents on the capital invested in the buildings was about 4 per cent. Building of dwellings by the works themselves insure the best results from an economic as well as from a national point of view.

658.3

How Can I Get My Plant Bulletins Read? *Factory*, Dec. 1923. v. 31, pp. 762-763, 790. Illus. This article not only tells how to sell the bulletin idea to the employees, it gives 12 ideas which have been successfully tried out, and is full of suggestions as to what to post.

658.3

How Plant Management Influences the Sales Department. G. A. Nichols. *Printers' Ink Monthly*, Jan. 1924. v. 8, pp. 37-38, 116. The story of the David J. Champion's plant and how he is applying the same principles of personnel relationship today as he did when his business was small. Contrary to present tendencies, Mr. Champion does not believe in building up a *system* for managing men. His theory is to inspire confidence and good will through the natural channels of intercourse.

658.3

How We Brought Management and Workers Together. W. W. Atterbury. *System*, Jan. 1924. v. 45, pp. 42-45, 108. Illus. and charts. A description of the Pennsylvania railway plan. Mr. Atterbury gives as his opinion that "One of the fundamental reasons for the success of the plan is the fact that it furnishes an outlet for the expression of opinions. It gives every worker on the system a voice that he knows will be heard if there is any merit whatever to his case. It gives him, also, complete protection."

658.3

Immigrant 10 Years in Melting Pot. F. B. Pletcher. *Iron Trade Review*, Dec. 20, 1923. v. 73, pp. 1665-67. Emphasizes the need for citizenship schools or for the industrial plant itself to train the alien, to teach him English as an aid to his advancement to higher stages of employment. Recommends some sort of "adjustment center" in industrial cities to aid the employer in getting the kind of semiskilled or skilled labor he needs.

658.3

Industrial Village on Sound Basis. *Iron Age*, Jan. 3, 1924. v. 113, pp. 9-14. Illus. The entire village, established in 1904 by J. A. Roebling's Sons Co., remains the property of the company. All matters between the residents and the company, all civic operations, as water, electricity, garbage disposal, street cleaning, etc. are handled and supervised by the head of the "Real estate department." It pays in promoting permanence of employment and the health of the employees, and in helping to solve the problem of assimilation of the foreign element.

658.3

Knox Factory Worker's Basis of New Marketing Plan. August Belden. *Printer's Ink Monthly*, Dec. 1923. v. 7, pp. 21-22, 74. Explains how the Works' Council idea was worked out and received and how new developments of co-operation had a direct bearing on sales and profits. The unit method in selling has been adopted by the Company to make it possible for dealers to increase their turnover.

658.3

Man—Management. W. J. Donald. American Management Assn. 1923.

Pamphlet, 8 pp. Personnel manager should be a man who can best advise line officers, executives and foremen in their responsibilities as managers of men.

658.3

One Man's Doctrine—The Employee Be Satisfied. P. H. Hayward. *Gas Age-Record,* Dec. 8, 1923. v. 52, pp. 713-15. Outlines in detail what the president of the Indiana Coke and Gas Company has done to remedy labor conditions through the organization of the Employer-Employee Association. Co-ordination of the desires of the workmen and those of the employee forms the basic idea of the association. Problems of low technical operating results, heavy labor costs and excessive labor turnover solved with resultant confidence between employer and employees.

658.3

Rational Works Management in Factories. X—Payment by Results. John A. Davenport and J. Inman Emery. *Industrial Management* (London) Dec. 13, 1923. v. 10, no. 12, pp. 326-327. Maintains that the worker who by extra effort contributes to an increase in production should receive a proportional increase in remuneration.

658.3

The Rise of "Industrial Democracy": VII—The Organization of Modern Industry. D. S. Kimball. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 45-49. Defines and describes Industrial democracy as the idea has developed and been known as Co-operative ownership, works councils, joint committees, etc. Industrial democracy is based on the same principles as representative government. The author points out some of the defects and difficulties but feels it holds a principle that is worthy of careful consideration.

658.3

Selecting the Supervisory Forces. Report of Committee on Supervisory Forces of American Management Association, 1923. *Pamphlet,* 15 pp. This enquiry is confined to the supervisory force, in administration and production, excluding the foremen.

658.3

Workers' Sickness Insurance in Austria. Fritz Hawelka. *International Labour Review,* Dec. 1923. v. 8, pp. 810-829. Workers of every kind, manual and non-manual, skilled and unskilled, can be insured without distinction in district sick funds, works sick funds, or other types of fund. In giving the history of the sickness insurance the author goes back to the first law of 1888. He traces the changes, shows the effect of the war and notes proposals for reform. In spite of the war the position of the funds seems to be financially sound, and statistics are beginning to show a return of the population to normal health conditions.

Production

658.53

Application of Charts in Industry. D. B. Porter. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 65-72. Charts. A comprehensive description of the graphic chart used in industry. The box, the bar, the historical, the Z chart and others are analyzed and the uses to which they are best suited are carefully presented. Article should be valuable to any one interested in the possibilities of the graphic chart.

658.5

A Co-ordinated System of Planning, Routing, and Cost Accounting—I. F. A. Waldron. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 39-43. Diagrs. Engineering, production, inspection, maintenance and accounting are considered the five main piers on which any manufacturing enterprise rests. The first two of these are mainly considered in this article, giving special emphasis to specifications and standards. Graphic charts present: Organization of the Engineering dept., Assembling diagram for military rifle, and the Operating organization.

658.53

Engineering and Business Charts. A. W. Swan. *Engineering Production,* Dec. 1923. v. 6, pp. 496-500. Illus. How to construct a clear and truth telling chart and how to determine the type best suited for the purpose it is to serve.

658.516

An Example of Standardization in German Industry. Dr. Leifer and Dr. Goller. *Mechanical Engineering,* Jan. 1924. v. 46, pp. 54-55. The standardization work of Siemens & Halske, Berlin, covers systematically every possible activity of the plant. The Standards department accepts the standards of the Normenausschuss der deutschen industrie, modifies them when necessary, and prints them in Siemens & Halske form. It also prepares its own standards, and provides for the co-operation of all departments. These standards sheets are minutely classified and indexed. Forms given.

658.5423

A Fourth Dimension for Measuring Skill for Obtaining the One Best Way to Do Work. F. B. Gilbreth & L. M. Gilbreth. *Society of Industrial Engineers Bulletin,* Nov. 1923. v. 5, pp. 6-7. Presents a method for skill measurement which furnishes records that are adequate, both in quantity and quality.

Careful study of the chronocyclegraph records shows a fourth dimension, time, which is emphasized in this paper. The authors have followed Einstein in calling this time element of skill a fourth dimension.

658.5

General Accounting as Related to Production Control. Percy Stotenbur. *Bulletin of the Taylor Society,* Dec. 1923. v. 8, pp. 241-244. Begins with Merchandise Inventory and tells how the system described enables one to know the value of this account each month. Brings out the problems of inventory and shows that various kinds of stock have entirely different turnovers. A practical article, but one which cannot discuss the subject in great detail in so limited a space.

658.58

Idle Capital in the Machine Shop. Arthur Easthope. *Engineering Production,* Dec. 1923. v. 6, pp. 474-479. Chart. Discussion. pp. 479-481. Idle machines mean idle capital. Discusses causes of lost machining hours and ways of reducing them. Gives chart for recording idle time with causes for same.

658.581

Modern Maintenance of Plant and Equipment: II—Work of the Millwright Department. W. G. Ziegler. *Industrial Management* (N. Y.) Dec. 1923. v. 66, pp. 347-353. Illus. Maintenance of the mechanical parts of the transmission equipment. Belts, pulleys, pillow blocks, friction clutches, exhaust fans, etc.

658.51

Planning the Repetitive Manufacture of Automobile Wheels. W. B. Ferguson. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 31-38. Illus., charts. An analytical description of methods employed to secure quantity production at minimum cost. Before the manufacturing of the Newport News Flexilient automobile wheel, one year was spent in designing, experimental and development work as to methods of performing the operations required. The author also tells of his experiences at the Remington Arms Co., 1916-17, where he installed time studies and rate setting and reduced pay-roll labor 33 per cent and increased output 72 per cent.

658.512

Progressing Work and Promises of Delivery. H. H. Southworth. *Industrial Management* (London), Nov. 29, 1923. v. 10 n. s., pp. 295-298. How to keep and how to watch order records and so be able to keep informed as to the probability of delivering goods on time. Blanks are given.

658.53

Relating Advertising to the Financing of a Business. R. R. Updegraff. *Advertising Fortnightly,* Dec. 19, 1923. v. 2, pp. 15-16, 44. The author aims to prove, by the use of three graphic charts, how a circulation statistical chart of a publication can present juggled figures misleading to the buyer of advertising space even though the figures remain mathematically correct.

658.5671

Salvaging Scrap in Cadillac Plant. *Iron Age,* Dec. 13, 1923. v. 112, pp. 1571-1574. Illus. Instead of allowing scrap to accumulate in the manufacturing departments, this automobile company has erected a separate building equipped for breaking up and mechanically handling long turnings. The output, which averages 15 tons a day, is immediately transferred to this building. Describes the method of handling and treating. One of the interesting features is the recovery of oil.

658.542
Solving a Sales Problem in the Factory. B. M. Maynard. *Factory*, Dec. 1923. v. 31, pp. 747-750. Charts. A metal working plant cut costs 30 per cent and applied a part of the saving to the selling price of its product. This was accomplished by a thorough study of operations. Stop-watch was used on each element of the whole operation and new rates based on results were instituted.

658.58
Some Practical Ways of Mounting Small Motors. H. S. Knowlton. *Industrial Engineer*, Dec. 1923. v. 81, no. 12, pp. 591-93, 611. Illus. Shows opportunities for economy in the use of individual motor drive for machine tools. The motor can be mounted so as to occupy space not otherwise useful.

658.531
A Time Ticket which Combines Production and Cost Data. L. W. Field. *National Association of Cost Accountants' Bulletin*, Nov. 15, 1923. no. 75 n. s., pp. 903-908. An analysis and discussion of a modern time ticket. While the ticket is similar to all such records in form it is utilized differently in that it forms the "keystone" around which production control methods center.

Shows how the Planning and Cost departments make use of the ticket.

658.516
What Simplification Has Done for Us. Louis Ettlinger. *Factory*. Dec. 1923. v. 31, pp. 744-747. How standardization in a garment industry has eliminated seasonal production and increased sales 25 per cent. Author contends that simplification in this trade is largely made possible by the tremendously increased per capita consuming power in America.

658.53
The Works Records Department—W. J. Hiscox. *Industrial Management* (London) Dec. 13, 1923. v. 10, no. 12, pp. 323-25. The first of a series of articles on the Records department. Emphasizes the value to works management, of collecting in one place for reference all documents and records kept by the various departments, relating to inspection, costing, stores, machine tools, etc.

Selling

658.808
Co-ordination of Production with Sales for Oil Companies. E. G. Reynolds. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 85-89. Charts. The purpose of a method for the co-ordination of production and sales in integrated oil companies, is to establish a program which will enable distant planning, provide a basis for predetermined consumption and surplus production, and be a guide in disposing of the surplus product of the refinery to greater advantage.

658.88
Cost of Carrying Overdue Accounts. J. W. Hallman. MANAGEMENT AND ADMINISTRATION, Jan. 1924. v. 7, pp. 63-64. "Accounts receivable" are a success or failure barometer of a business house. The author claims that to call on a delinquent customer will frequently result in the settlement of account, a continuance of business, and often new business. Other difficulties may be overcome by the "Shock absorbing account" method described by him in MANAGEMENT AND ADMINISTRATION for Oct. 1923.

658.82
How Pillsbury Sells the Turnover Idea to the Grocer. G. A. Nichols. *Printers' Ink*, Dec. 20, 1923. v. 125, pp. 17-20. The Pillsbury plan was designed as a direct method of increasing the company's sales to the grocer and to widen the market for its full line. They offered a "Turnover Insurance Policy" which is Pillsbury's national advertising, the biggest form of turnover insurance procurable. It insures that their merchandise will move, that the product will turn quickly.

658.8
Keeping the New Salesmen from Slipping. C. B. Larrabee. *Printers' Ink Monthly*, Jan. 1924. v. 8, pp. 23-24, 118. It is up to the sales executive to see that the salesman makes good on the road. How this is done is told in this article by an examination of methods in use by such firms as National Cash Register Co.—National Biscuit Co.—Royal Baking Powder Co.—E. R. Squibb & Son, etc.

658.82
Knox Factory Worker's Basis of New Marketing Plan. August Belden. *Printers' Ink Monthly*, Dec. 1923. v. 7, pp. 21-22, 74. Explains how the Works' Council idea was worked out and received and how new developments of cooperation had a direct bearing on sales and profits. The unit method in selling has been adopted by the Company to make it possible for dealers to increase their turnover.

658.82
The Science of Marketing by Mail. Homer J. Buckley. *Forbes*, Dec. 8, 1923. v. 13, pp. 271-272, 281. Salesmen waste time in going after men who are not real prospects, and in not being able to answer questions. To eliminate this waste and bring about more contentment among salesmen a regular system of mail advertising should be carried on. Gives many illustrations indicating that the mail method of advertising is a sure way of cutting sales costs.

658.824
65 Per Cent More Sales and Closer Collections Through Letters. H. W. Cockron. *System*, Jan. 1924. v. 45, pp. 27-29. Illus. A small business in a small town found direct mail to be a better advertising medium than the newspaper. The business being food-supplies, letters and cards are addressed to the housewife.

Gives sample letters. The letter which brought the best results was an endeavor to collect bank accounts.

658.82
Staking a Comeback in a Neglected Market. Roy Dickinson. *Printers' Ink*, Dec. 20, 1923. v. 125, pp. 113-122. Methods adopted by an underwear manufacturer to get back to the leading jobbers in the New York Metropolitan district. Missionary salesmen, with a promise of permanent positions if they made good, were trained to carry on the campaign and reclaim the trade which had been neglected nine years. The retailer was offered a service as well as the merchandise.

658.882
Using Ledger Records for Gaging Credits. C. V. Howard. *Iron Age*, Dec. 27, 1923. v. 112, pp. 1728-1729. Briefly outlines the purpose of the Interchange bureau of the N. Y. Credit Men's Association, whose tabulated reports help business houses to solve their credit problems, and to minimize "bad debt" waste.

658.8(002)
What Does Your Selling Expense Include? W. R. Basset. *Advertising Fortnightly*, Jan. 2, 1924. p. 14. How much of the selling cost should be charged to manufacturing? If an activity helps to sell the product, or if the sales department by selling in distant territory entails an extra expense, the cost is a selling cost; but if the manufacturing is benefited, it is a manufacturing cost.

Storage Material Control

658.7884
Applying Science to Crating. Earl Christmas. *Industrial Management* (N. Y.) Dec. 1923. v. 66, pp. 361-366. Illus. Experience of engineers who were employed by a large lumber company to make a survey of crating practice of American shippers. Gives designs which were worked out with the purpose of reducing cost, insuring safety, saving material and reducing weight.

658.787
Making Short Work of Inventory Taking. Editors of *Factory*. In Factory, Dec. 1923. v. 31, pp. 764-766. Some short-cuts in methods of taking a physical inventory. Covers counting, weighing, measuring, nomenclature, physical or chemical condition, and inspection for accuracy. Shows methods of planning and execution.

658.783
Modern Practice in Stores Management: IV—Stores Accounting. W. D. Gordon. *Industrial Management* (N. Y.) Dec. 1923. v. 66, pp. 320-326. Charts. How and what stores records to keep that will give exact information at any time of amounts of materials on hand, ordered or received. Such records make physical inventory unnecessary. Daily reports can serve as basis for cost charts.

658.78
Reclamation Storeroom Accomplishes a Big Saving. *Electric Railway Journal*, Dec. 15, 1923. v. 62, p. 1004. Short account of system developed by

the Northern Texas Traction Company for reclaiming waste material; viz., Organization of reclamation room under supervision of master mechanic with one experienced man in charge; room serves as repair shop and store-room; material carefully examined and decisions made as to repairing or scrapping; application for all supplies sent here first and if unavailable, requisition is written by man in charge on the general store-room. 56 per cent of calls for material supplied by reclamation room.

Article based on brief submitted to the C. A. Coffin prize committee of the American Electric Railway Association.

Relation of Stores and Mechanical Departments. F. M. A'Hearn. *Railway Mechanical Engineer,* Dec. 1923. v. 97, pp. 834-838. Illus. Gives practice of the Bessemer and Lake Erie railroad in handling certain stocks, as an example of efficient co-operation between stores and mechanical departments. Records made at monthly inspection of locomotive show condition of parts. By these records material needed for future repairs is estimated, thus allowing ample time for the placing of orders and keeping down the amount of material in stock. Also covers the plan of the stores department and the disposal of scrap material.

658.788

Shipping Service Cuts. Freight Cost. E. C. Kreutzberg. *Iron Trade Review,* Dec. 20, 1923. v. 73, pp. 1670-71, 1677. Describes the service rendered by the consolidation of less-than-carload shipments into carloads. Several companies are now in this business. The saving to shippers of these less-than-carload shipments averages 10 to 15 per cent of the railroad freight rates. Much time is saved, and a great deal of handling and tracing eliminated.

Technical

621.311

Draft Control for Cutting Down Boiler Losses. Robert June. *Gas Age Record,* Dec. 22, 1923. v. 52, pp. 763-5. Draft regulation one of the most important factors in maintaining combustion efficiency. There is one best draft for each boiler with a given fuel and a given rate of combustion. This best draft can be readily determined by experiment. Chart gives a good idea of the draft required to burn a number of the most commonly used steam coals at various rates of combustion.

Various controls considered and points given for purchasing controlling devices. From point of view of the managing executive.

621.63

Electric Drive for Centrifugal and Propeller Fans. Gordon Fox. *Coal Industry,* Dec. 1923. v. 6, pp. 503-7. Valuable technical information for the man who wants to know what type of fan to select for a given purpose. Gives characteristics of fans operated at various percentages of rating with curves showing pressures, velocity heads, horsepower required and efficiencies.

662.6

The fundamentals of Fuel Economy. W. L. Richards. *Railway Mechanical Engineer,* Dec. 1923. v. 97, p. 809. Abstract of a paper which won the prizes in the International Railway Fuel Association contest. Fuel economy considered from three viewpoints, viz., operation, mechanical and personnel. Deals with the fundamentals of the subject in a constructive and suggestive manner.

662.76

Gas the Ultimate Fuel for Industry. H. O. Loebell. *American Gas Journal,* Dec. 29, 1923. v. 119, pp. 673-75, 84. Two basic considerations discussed: scientific factors involving effective utilization of the fuel for industrial heating, and the economic factor involving present cost of fuel and future lower rates. Central station considered as the ultimate solution for community supply, and development of more efficient gas furnaces to mark future progress.

620.123141

Metals in Engineering Service. Gordon Sproule. *Engineering Journal of Engineering Institute of Canada,* Dec. 1923. v. 6, pp. 523-30. Illus. Discusses the service of metals as affected by quality and suitability of material and by features of mechanical design. Emphasis laid on inspection of failed material by metallographic examination, and by elimination of bad material. Article will be of value to those interested in the engineering side of inspection.

621.8

Modern Maintenance of Plant and Equipment: II—Work of the Millwright Department. W. G. Ziegler. *Industrial Management* (N. Y.) Dec. 1923. v. 66, pp. 347-353. Illus. Maintenance of the mechanical parts of the transmission equipment. Belts, pulleys, pillow blocks, friction clutches, exhaust fans, etc.

625.17

Motor Car Repair and Operation Require Supervision. R. J. Watt. *Railway Engineering and Maintenance,* Dec. 1923. v. 19, pp. 485-87. Outlines the organization for the maintenance of section and inspection cars, as used in the maintenance of way department of the Louisville and Nashville railroad.

621.18214

Pulverized Fuel and Efficient Steam Generation. David Brownlie. *Iron and Coal Trades Review,* Dec. 14, 1923. v. 107, pp. 889-90. A technical article on study of records at Underfeed Stoker Co. of London, which show reliable and extension data on the performance of pulverized fuel, including figures not heretofore published under one head. Brings out the fact that no adequate records are kept for mechanical stoking. Efficiency figures are given for various pulverized fuel stations in America and Great Britain. Includes drawing of cross section through boiler plant equipped with Lopulco Pulverized Fuel system.

621.182

Waste Heat Boilers. C. H. Bamber. *Gas World,* Dec. 15, 1923. v. 79, no. 2056, pp. 546-549. The use of boilers for absorbing waste heat from hot gases. A satisfactory waste heat boiler will enable a water gas plant to supply almost all the steam it requires for its operation. Considers water-tube boilers, fire-tube boilers, heat available from retorts and from gas engine exhaust.

621.31003

What Does the Super Power Plan Mean to You? Guy E. Tripp. *Industrial Management,* (N. Y.) Dec. 1923. v. 66, p. 345-346. This question which has heretofore been considered in its national aspect is here narrowed down to the individual manufacturing plant to see what the super power plan will do for production costs and for the individual consumer.

Training

658.386

Assimilating the Factory Foreman. Article 2 of a Training Program for the Factory Foreman. J. K. Novius. *Open Shop Review,* Dec. 1923. v. 20, pp. 422-26. A suggestive rather than an exhaustive article. Shows what training does for the foreman in improving his methods and broadening his outlook. Foremen training is a sort of insurance for the future.

658.386

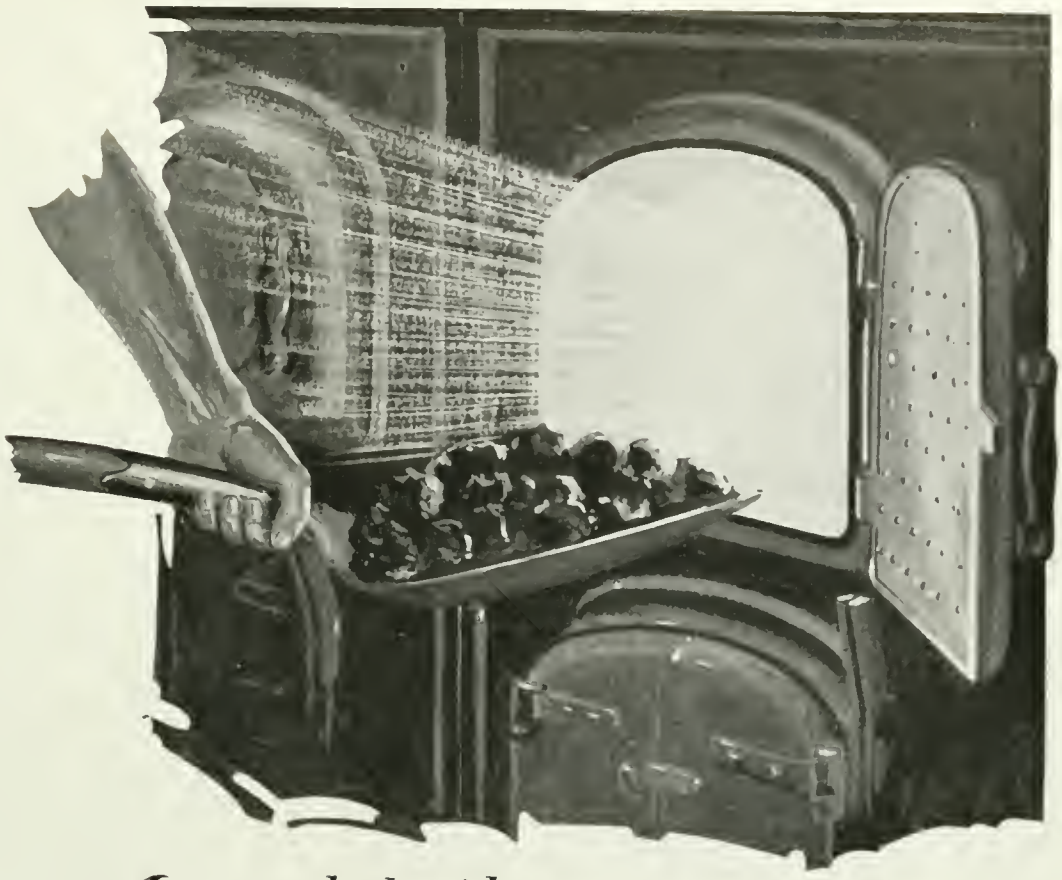
Business Economics Taught to Workers at Delco Plant. Harry Tipper. *Automotive Industries,* Dec. 13, 1923. v. 49, no. 24, pp. 1194-95. Aims to present to the men the fundamentals governing business, and so acquaint them with all kinds of problems outside their usual surroundings, and lead them to do their own thinking. Gives a list of subjects included in the course.

658(07)

Engineering Education and American Industry. National Industrial Conference Board. Special Report no. 25, Aug. 1923. *Pamphlet,* 25 pp. Emphasizes the need for trained leadership in industry, and the necessity for co-operation between engineering schools and industries in the development of men fitted for positions of leadership.

658.386

The Fundamentals of Apprentice Training and Industrial Relationship. A. E. McClintock. *Open Shop Review,* Dec. 1923. v. 20, pp. 435-38. Economic necessity and self-interest, the determining factor in apprentice training. Industry lags where apprentice training is considered expensive. Apprentices will not be trained until advantages to employer are commensurate with cost. Logical way to establish close personal relationship is through the foreman, and the company must first sell itself to him before it can sell itself to its employees. Article confined to foundry.



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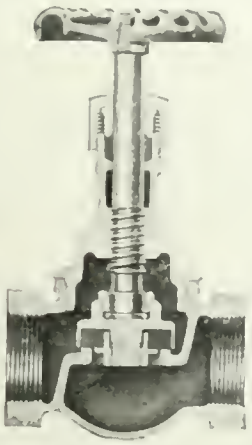

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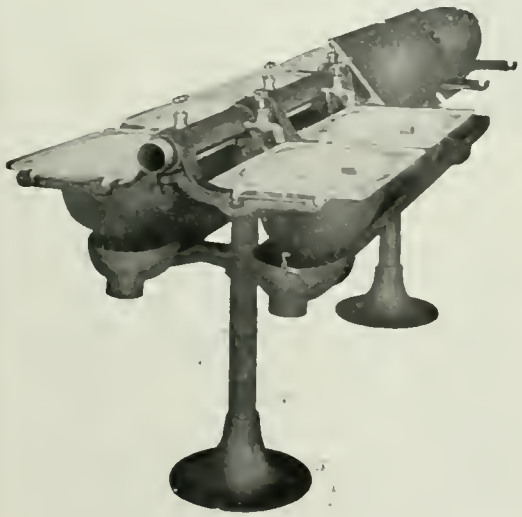

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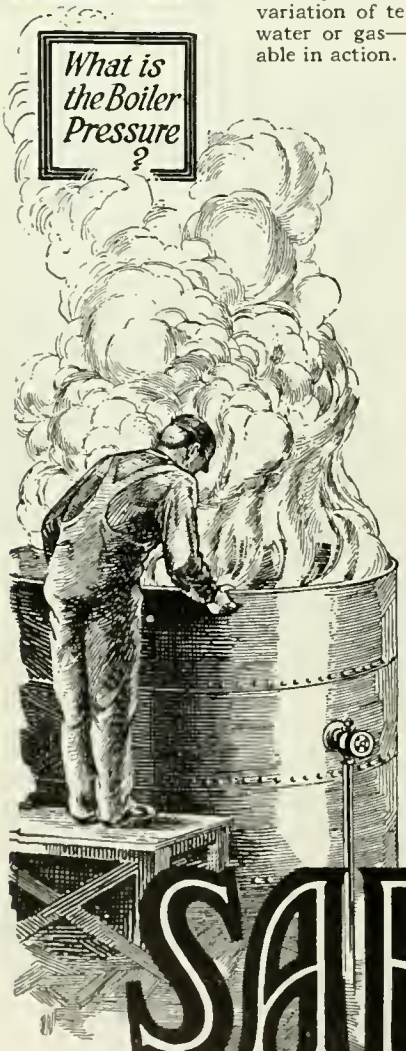

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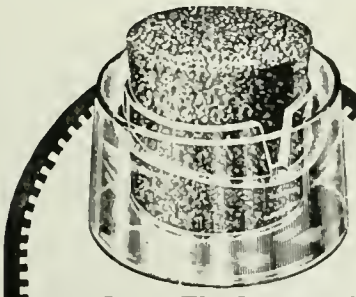

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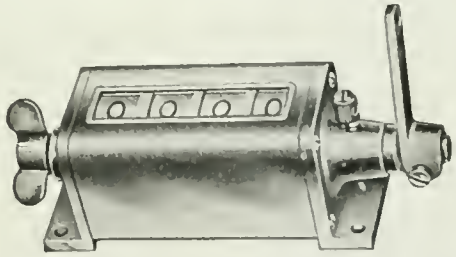

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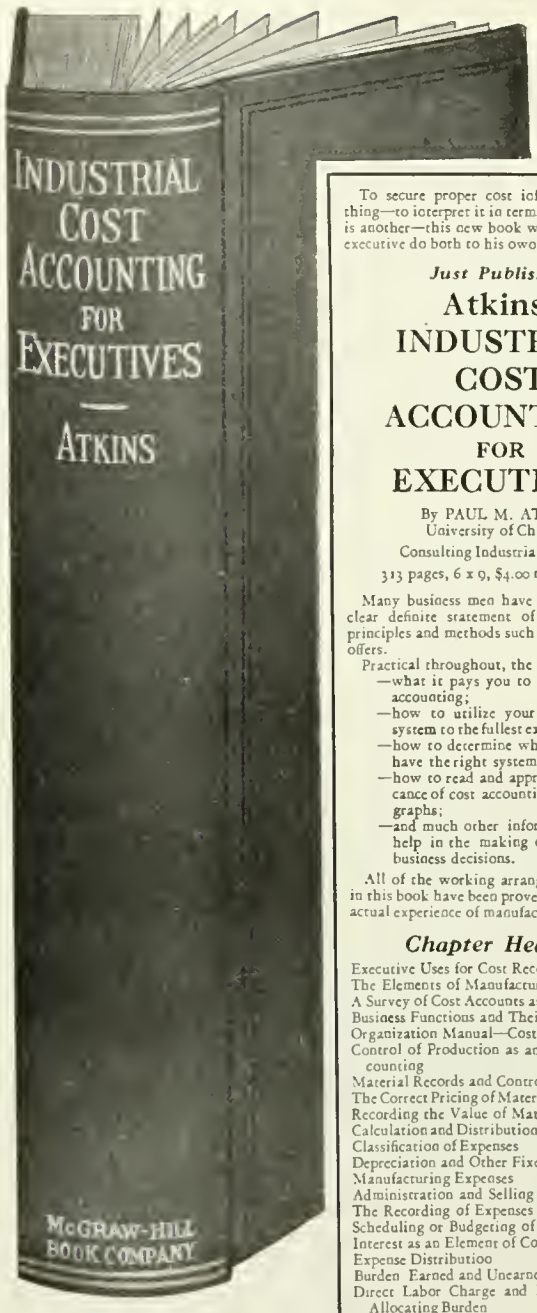

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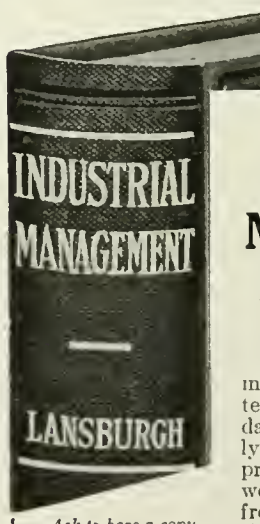

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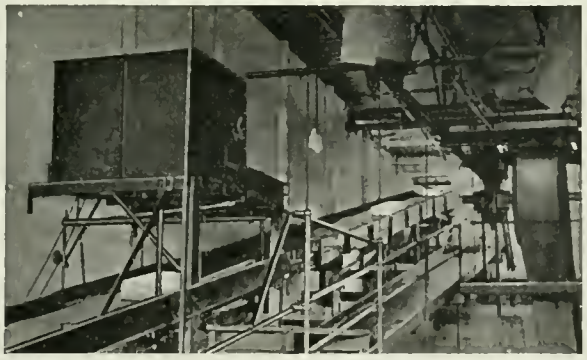

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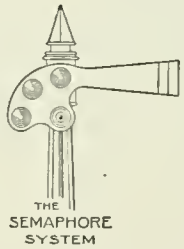

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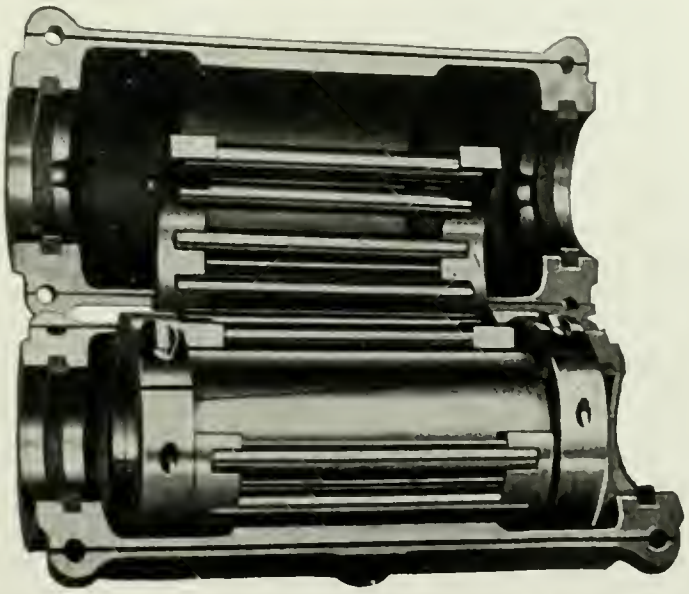
For dealer nearest you see MacRae's Blue Book



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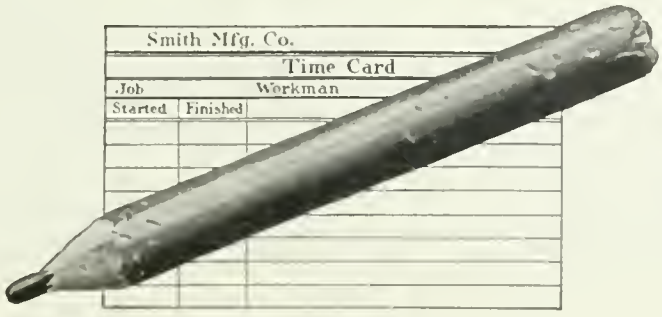

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Their interests are centered in other matters. When a job is finished they guess at the time which it took. Those guesses go to form the basis of your cost data. And it is a ten to one bet that your cost records are inaccurate.

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THE CALCULAGRAPH

THE ELAPSED TIME RECORDER

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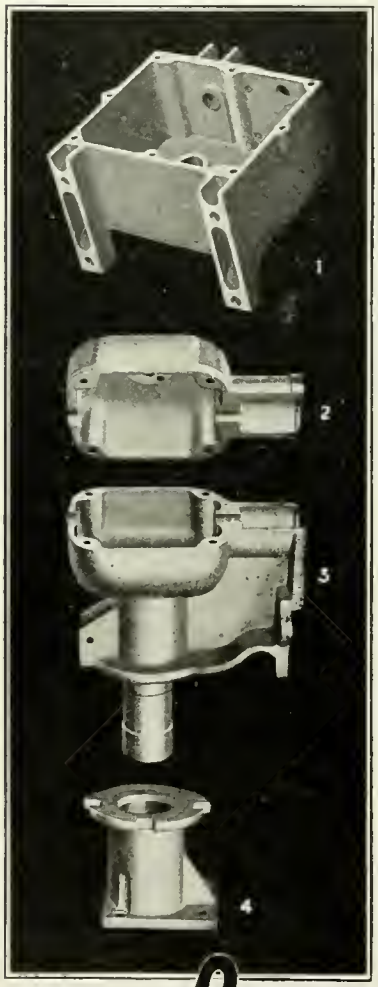

THOSE who have visited this great factory have been astounded at our tremendous facilities, at the millions of die castings which we turn out and at the thoroughness of our metallurgical work.

Great machines of our own invention shoot out castings accurate to the thousandth of an inch at an unbelievable rate; dies made in our own departments represent developments in the industry which were thought impossible a few months ago; our engineering and metallurgical departments are perfecting alloys to the uses of the castings to add strength, lightness, hardness and ductility as desired.

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3 Die casting this part alone saved eleven operations such as (1) turning stem, machining flange, drilling ⅜-inch hole, counterboring one inch deep, (2) roughing and finishing top face, (3) milling locking slot, (4) facing bosses inside, (5) milling pad lor bracing beam, (6) drilling eight holes, (7) tapping seven holes, (8) inserting bushing, (9) assembling with cap, (10) grinding parts 2 and 3 flush, (11) disassembling.

4 Six machine operations were saved by die casting this part. Such examples ol actual production economies only suggest the possibilities in many other businesses. Send us your blue prints.

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Printing of this issue, 14,000 copies

Authors and Articles in this Issue

DWIGHT F. DAVIS is Assistant Secretary of War and writes with authority of the preparedness program of the United States government. The plans he discusses do not go as far as the actual construction of foundries and factories for the manufacture of material of war, but are closely restricted to a survey of existing facilities and an agreement with their owners that will place these facilities at the disposal of the government in time of need—plans "exactly similar to those laid in every well-run business to provide for emergencies likely to arise".

Donaldson Brown, Vice-President of General Motors Corporation contributes a second article on "Pricing Policy in Relation to Financial Control". A third article, discussing the application of the principles laid down in the two preceding articles will appear in the April number of MANAGEMENT AND ADMINISTRATION.

"Underfeed Stokers and Economy in Coal," is by **Joseph G. Worker**, President of the Stoker Manufacturers Association. The article, which follows the general line of Mr. Worker's recent address before the Chicago Section of the American Society of Mechanical Engineers, tells briefly how the underfeed stoker was developed in response to a demand for higher thermal efficiency; describes its operating principles; and mentions some typical western installations.

"Operating Factory Divisions by Budget," by **Thomas B. Fordham**, Superintendent, and **Edward H. Tingley**, Engineer, of the Delco-Light Company, is the fourth and concluding article of the series "Applying the Budget to Industrial Operations". The article shows how an analysis of estimated and actual costs is made by divisions and departments as a check-up on operating expenditures and activities.

The article "Organization of Inspection and Maintenance," is the third in the series, "A Co-ordinated System of Planning, Routing, and Cost Accounting." The author, **Frederick A. Waldron**, now Consulting Engineer, was formerly Superintendent of the National Cash Register Company.

"Methods of Analyzing Financial Reports," by **J. H. Bliss**—the fourth article in the series "Capital Requirements and Control"—is a detailed discussion of the profit and loss statement and the balance sheet, "further to emphasize and illustrate practical methods of analyzing financial statements".

Geoffrey C. Brown contributes "Production Control in a Small Organization," the second article of his series, "Profitable Methods for the Small Factory," showing how production controls should be organized, both as regards function and personnel. A number of forms are given which have been used in a plant employing about 100 men.

"Factory Pay-Roll Control in the Shirt Industry," by **Michael L. Siegel**, Factory Payroll Auditor of S. Liebovitz and Sons, Inc., is a record of experience. The plan described covers both main and branch office control.

"Reducing the Cost of Shop Trucking," by **Robert T. Kent**, is a practical discussion of the problems involved. In one case instanced by Mr. Kent, the trucking force was reduced from 90 to 10 men and an annual saving effected of over $63,000.

Milton L. Oglesby is Engineer of the Freight Container Bureau of the American Railway Association. His article, "Formulas for Shipping Box Construction," is the result of a vast amount of actual experiment and field investigation. It gives the formulas to be used in calculating the thickness of lumber used in shipping box construction.

David B. Porter in "Application of Charts in Industry," describes the charts best suited for industrial and business purposes and explains the manner of their use. The author is Assistant Professor of Industrial Engineering in New York University, was for some years on the staff of H. L. Gantt, and has had a considerable practical experience in metal working and textile plants.

"The Industrial System and the Price System," the second article of the series "Economic Problems of Industrial Organization," by **Frederick C. Mills**, takes up the price margin showing how this margin, or differential, affects the flow of manufactured goods.

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THE PUBLISHERS' PAGE

Wanted!

Readers' Contributions and Discussion

MANAGEMENT AND ADMINISTRATION belongs to its readers; is for them and of them. Not only is it subscribed to by men who are responsible for determining policy and getting work done, but it is written by men who are directing operation.

The analysis of subscribers as of December 1923, classified by position, proves the first statement that it goes to responsible men.

	Copies	*Percentage*
Corporations and Partnerships	2073	16.68
Owners, Partners, Officials, and General Managers	3480	28.00
Departmental and Senior Managers and Executives	2031	16.34
Technical Executives, Consultants, Accountants, and Engineers	2104	16.93
Junior Executives and Miscellaneous Occupations	1241	9.98
Awaiting Classification	1499	12.07
Total	12,428	100.00

The truth of the second statement is shown by the list of authors who have written for the first three numbers of 1924.

Position	*Articles*
Secretary of the Treasury of the United States	1
Assistant Secretary of War	1
Executives of Industrial Concerns	21
President	2
Assistant to President	1
Vice-President	3
Controller	6
Superintendent	3
Sales Manager	2
Credit Manager	1
Statistician	3
Engineers, Mechanical, and Industrial	13
Educators	4
Others	2

To keep the editorial pages up to the standard set by these three numbers, a continuous flow of useful, worth-while contributions is needed. Here is where the subscribers can help themselves, their fellows, and their magazine by writing of their matured practice and experience as managers and executives.

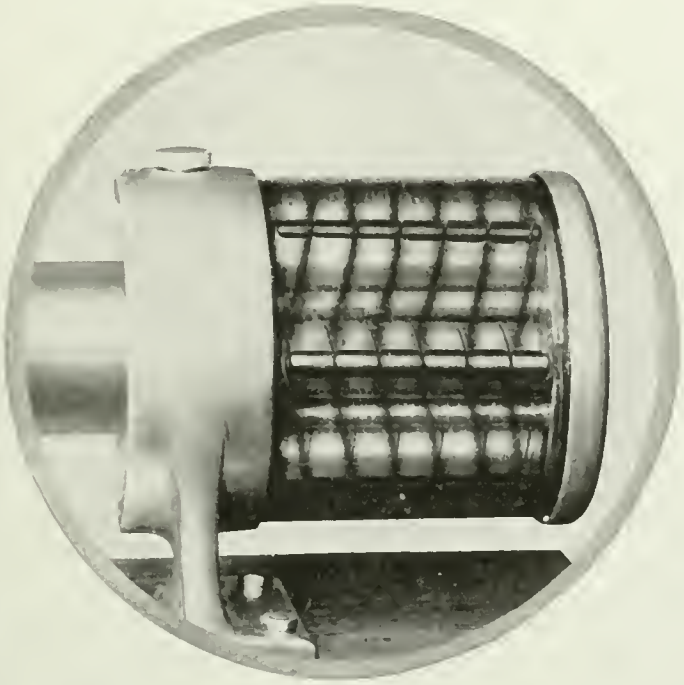
Such articles may be of a nature and length to adapt them to the body of the magazine, say 4 to 6 pages in length. Particularly desirable also are discussion, criticism, or amplification of articles already published, comments on timely management topics, and questions.

The work of preparing contributions of this kind brings its own compensation, for the rewards of authorship are many and generous. Among the major ones are: Through the printed article new acquaintances are made and business relations often follow, assistance is given to others by means of the usable information and practically applicable experience, and satisfaction is felt in adding to the total of human knowledge.

No special requirements in the preparation of manuscript need be followed; those which usually prevail are quite sufficient. Good typewritten copy —double space with wide margins—is preferred. Photographs, diagrams, charts and tables, if really in point, are particularly desirable. Charts and diagrams need not be finished in ink. Clear pencil sketches, photostats, or blueprints are satisfactory.

Your contribution on any topic in the field and scope of MANAGEMENT AND ADMINISTRATION will be welcomed and will be given careful consideration. For acceptable major articles a honorarium is tendered at the time of publication. In sending in an article just address it to "The Editors."

Did You Ever See a Hyatt Roller Bearing *In a Glass House?*



Here is a Hyatt roller bearing mounted in glass instead of steel to enable you to observe the circulation of the oil.

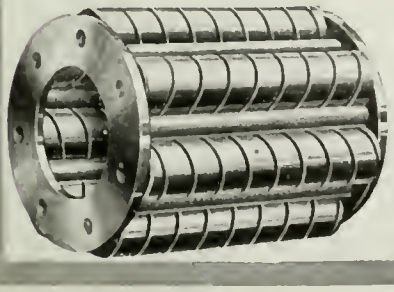
As the hollow rollers revolve, the oil flows out of the slots in parallel bands which cover the entire bearing surfaces. As long as any oil remains in the bearing it will be constantly picked up by the rollers and distributed in the path of the following rollers.

Because of this positive, self-oiling feature of Hyatt roller bearings it is only necessary to add lubricant to them occasionally, usually 3 or 4 times a year, which makes a worthwhile reduction in lubrication costs, oil and labor.

This positive, self-oiling feature of Hyatt roller bearings is only one of their good points.

Their true rolling motion saves power and manual effort in worthwhile amounts and their durable high grade steel construction enables them to effect these economies throughout the life of a machine without adjustment or replacement.

Specify Hyatt roller bearings for your cranes, trolleys, hoists, conveyors, for industrial trucks and trailers, machine tools, lineshafts and every kind of machinery where economy and dependability of operation are desired.



Hyatt Roller Bearing Company

Newark Detroit Chicago San Francisco

Worcester Milwaukee Huntington Minneapolis Philadelphia

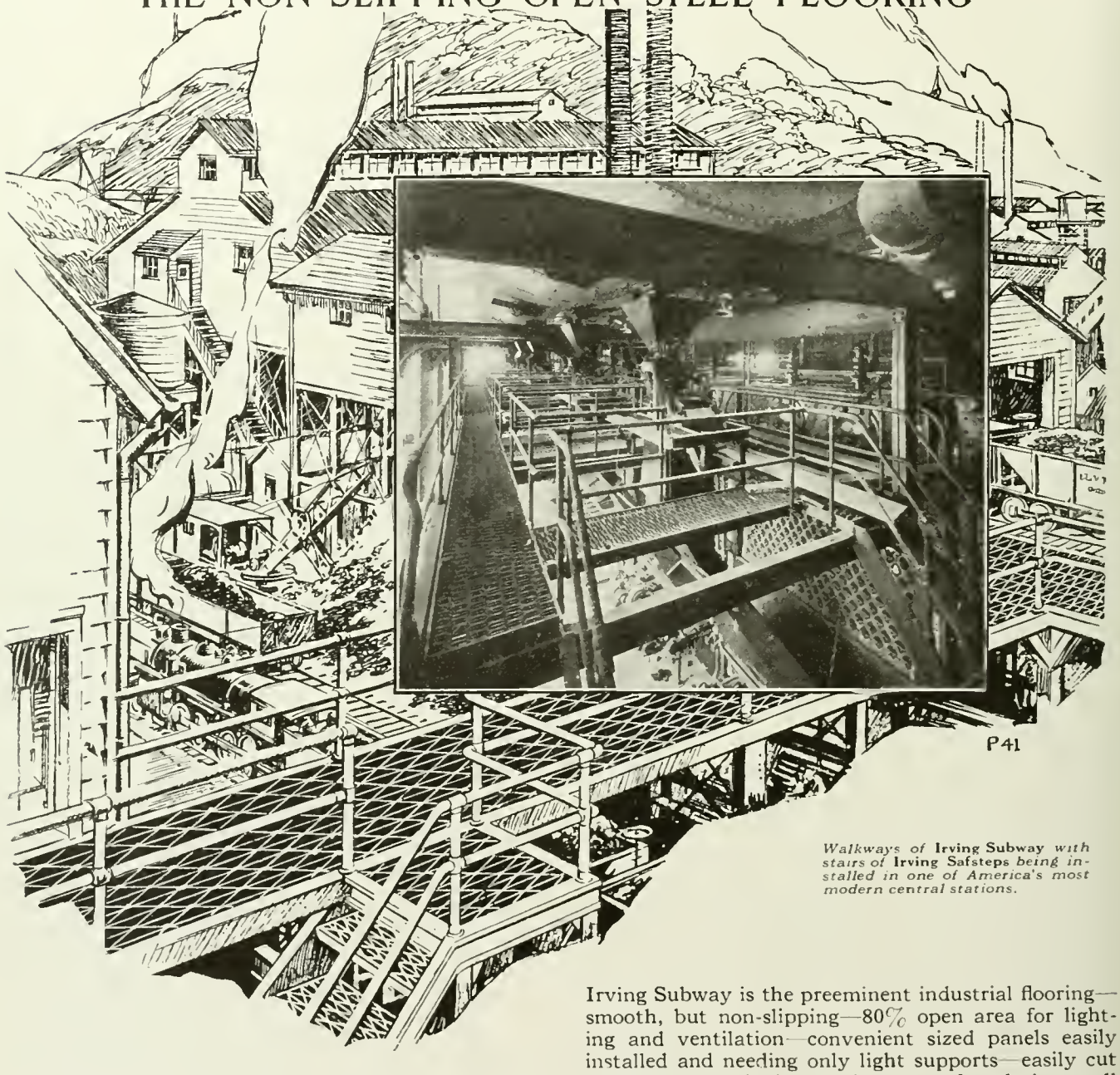
Cleveland Pittsburgh Buffalo Indianapolis

IRVING SUBWAY

TRADE MARK

PATENTED REG.U.S.PAT.OFF.

THE NON-SLIPPING OPEN STEEL FLOORING



Walkways of **Irving Subway** *with stairs of* **Irving Safsteps** *being installed in one of America's most modern central stations.*

In-built safety and comfort—for the man who must stand or walk or work or wheel upon it—are distinctive features of this modern steel flooring. And for the man who buys it, there is the maximum of underfoot efficiency, the maximum of durability, the minimum of installation and up-keep costs.

Irving Subway is the preeminent industrial flooring—smooth, but non-slipping—80% open area for lighting and ventilation—convenient sized panels easily installed and needing only light supports—easily cut or fitted around pipes, columns or foundations—all the durability of steel. And the Irving reputation and experience are a guarantee of quality—while the Irving plant (the largest steel flooring factory in the world) is a guarantee of delivery. Write for Catalog 4A-44.

IRVING IRON WORKS CO.

LONG ISLAND CITY, N.Y. U.S.A.

CONDITIONS AND PROSPECTS IN BUSINESS AND INDUSTRY

PREPARED BY LEWIS H. HANEY

Director, New York University Bureau of Business Research [1]

Barometer of Industry and Trade

Industry and Business on the Up-grade

The forecast for the next six months continues favorable. Seldom have the indications of business trend been so nearly unanimous as at present. Taken as a whole, industry and business should continue on the up-grade at least until this fall.

The P/V line rose further in January. The diminishing failure bars indicate improved business conditions. The price arrow points upward. The interest-rate curve, while turning up after eliminating seasonal trend, is still below the center of the normal area. The reserve ratio continues to indicate a very ample credit basis. (See Fig. 1).

Recent Developments. The most marked changes during the past month are the following:

1. The trend of the price level has become more clearly upward. The number of commodities advancing in price has been greater than those declining. The Bureau's special six-commodity index advanced in January as did Dun's index. A very small decline in Bradstreet's was due to the cotton textile situation.
2. Business and industry have passed the bottom of the 1923 recession.
3. Production in basic industries is on the increase with the iron and steel output growing and the volume of railway tonnage sharply rising.
4. Business activity as measured in sales is increasing. Mail order sales, bank debits, and imports all advanced during January.

A natural question at this time is, Where are we? The answer may throw light on where we are going. A study of the most significant indexes of business and industry leads to the following conclusion: Beginning about August

[1] Assisted by Horace J. Barney, Harry Comer, and Stephen DuBrul of the Bureau's Staff.

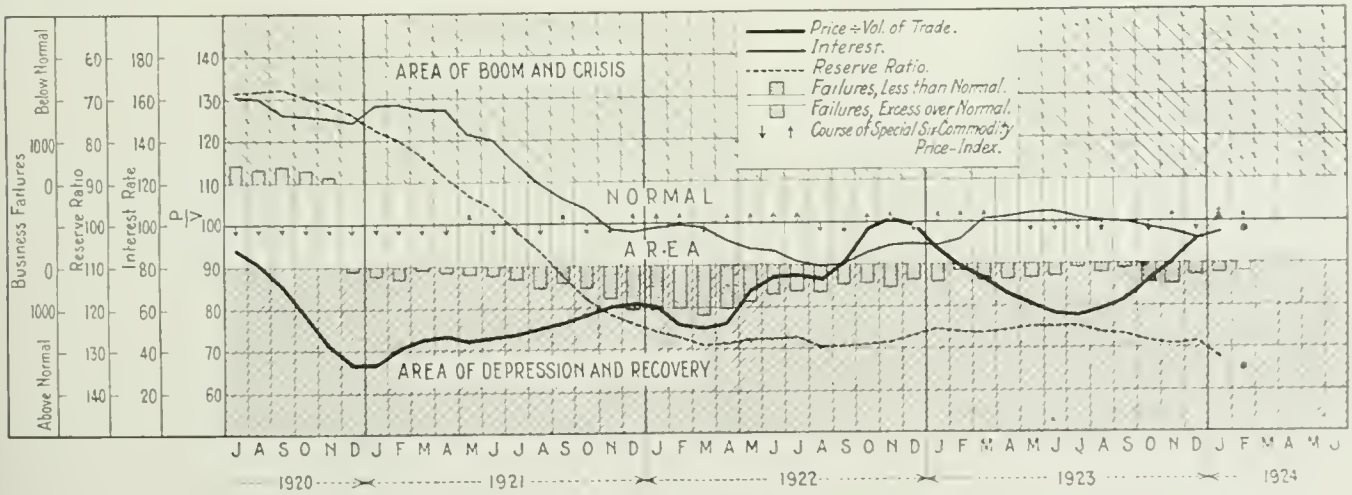

Price÷Vol. of Trade.
Interest.
Reserve Ratio.
Failures, Less than Normal.
Failures, Excess over Normal.
Course of Special Six-Commodity Price-Index.
AREA OF BOOM AND CRISIS
NORMAL AREA
AREA OF DEPRESSION AND RECOVERY
Business Failures
Below Normal
Above Normal
Reserve Ratio
Interest Rate
P/V
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1920
1921
1922
1923
1924

FIG. 1 THE BAROMETER OF INDUSTRY AND TRADE

The P/V line (drawn heavy) is the main forecasting line.* It shows the trend of commodity demand, and is the ratio between Bradstreet's index of wholesale prices and the physical volume of trade (carloadings times tons per car), based on 1912 as the normal year. It is plotted as a three months' moving average, centered successively on the middle months, except that the final dotted portion of the line runs to the actual figure for the last month. A rise in the curve indicates increasing demand, and vice versa. The interest rate curve has been corrected for seasonal variation, and index number 100 equals 5 per cent. The federal reserve ratio of cash reserves to note and deposit liabilities is inverted to harmonize its indications with the rest of the curves, and is corrected for seasonal variation. Business failure bars are based on Dun's reports, and normal is taken as the trend for 40 years. The six-commodity price index is based on special investigation by the N. Y. U. Bureau. February 1924 data shown are probable trends. Areas in which curves lie indicate that business is good, normal, or poor.

* In this issue an improvement is made in the computation of the P/V line. No change in the month to month trend is involved, and no forecasts are in any way affected. On the basis of additional data the normal growth of tonnage has been recomputed by the Bureau, resulting in the establishment of a smaller allowance for such growth. It is believed that the P/V line now lies approximately in its proper place with reference to the normal area and thus gains an added significance.

1921, business picked up and reached a peak in the early part of 1923 which was between 50 and 60 per cent above the low level. Then came a minor reaction which lasted till the end of 1923 and which brought business down from the peak by an amount equal to between 15 and 25 per cent. With the turn of the year 1924 there has come a recovery which has already raised the level of business from the recent low point about 6 to 10 per cent. We may, therefore, conclude that during the 1923 recession only a part of the 1921-1923 gain was lost (about one-third); and that now we have already recovered about one-half of that loss. Production is still considerably below the 1923 peak—about 10 per cent.

In "business," as distinguished from industrial production, the changes have not been so marked and the recent recovery has been greater. Business is only approximately 5 per cent under the 1923 peak.

Favorable and Unfavorable factors. A list of the favorable and unfavorable factors as they appear in the middle of February is as follows:

Favorable Factors

1. Bank debits increase. (Fig. 9)
2. Mail order sales increase. (Fig. 10)
3. Building activity shows sharp gains. (Fig. 6)
4. Unfilled steel orders increase. (Fig. 3)
5. Imports increase. (Fig. 7)
6. Car loadings, production of steel ingots, pig iron, and coal increase. (Figs. 2, 3, and 5)
7. Prices advance. (Fig. 11)
8. Business failures decline. (Fig. 12)
9. Money and credit easy. (Fig. 13)
10. Heavy production and sales without "pyramiding," or accumulation of inventories.
11. Continued caution in buying shows business men still remember 1920-1921.
12. Improved European situation.
13. Radical legislation not likely.

Unfavorable Factors

1. Slight decline in new business enterprises. (Fig. 12)
2. Unsettled conditions in several important industries—textile, coal, copper. (Fig. 3)

We must conclude that there is no indication of any important setback in business or industry, that the bottom of the 1923 recession has been passed, and that the outlook is for continued gains.

Future Dangers. It may be helpful to list the dangers which lie ahead, any one of which may become an important factor within the course of the next year or two.

Future Dangers

1. Credit inflation.
2. Bidding up of wages.
3. Increased volume of sales based on credit (houses, automobiles, radios, furniture.)
4. Termination of the building boom.
5. Withdrawal of European capital.

These are the things which business men should watch.

At present, signs of inflation are absent, but in the midst of such political upheavals it would be out of the question to deny the possibility of its development. Early notice of any such development will be given in these pages when evidences become apparent.

There is little doubt that the large volume of sales "on time" is a real factor. The people are being encouraged to buy automobiles and other items on the instalment plan, and some businesses complain that their sales have been curtailed by the extension of easy credit in others. It is not unlikely that when the next general setback in business comes it will be featured by heavy liquidation in mortgages on homes, automobile credits, etc.

When European conditions become stabilized it is probable that considerable funds will be withdrawn and return home. The best opinion is that this will not be a serious factor.

Production and Stocks of Commodities

Production Gains: Commodity Stocks Stabilized

Stocks of Commodities

Zinc stocks show an increase of 11 per cent during January, but the increased buying activity in the galvanized iron market is holding the price up.

Newsprint paper stocks declined 1½ per cent during January, strengthening the situation in that industry. Auto tires showed a further decline of 8 per cent during the same month. Merchant pig iron stocks increased 2½ per cent, which is the smallest rise since the stocks of iron began to increase last April. It is expected that this index will decline during February.

Production and Railway Tonnage

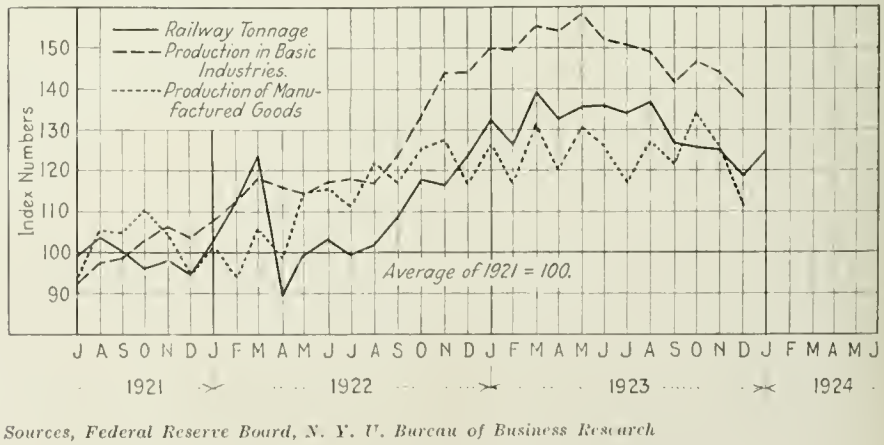
Railway Tonnage. Fig. 2 shows a sharp recovery in railway tonnage in January. The index is back to a little above the level of October and November, after making allowance for the usual seasonal variation.

Production. Production in basic industries and in manufactures was lower in December than in the preceding month. In the Bureau's judgment this index reached the bottom in December. Production in basic industries was 13 per cent below the 1923 peak.

Conclusion. The recovery in railway tonnage in January forecasts an increase in production in basic industries for that month. Production bids fair to increase from now on. The situation at the present time may be summed up as follows: Tonnage in December was down 15 per cent from the 1923 peak. In January it moved up 7½ per cent above December, and is now less than 10 per cent below the 1923 peak.

Iron and Steel Production

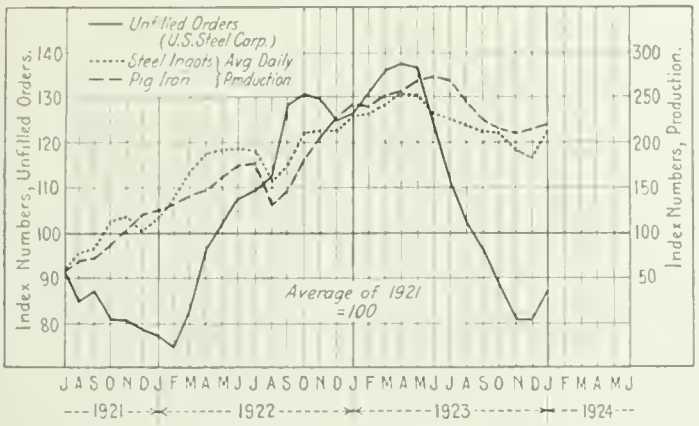
Production. During January the average daily production of pig iron, Fig. 3, after allowing the usual seasonal change, showed an increase of 2½ per



Sources, Federal Reserve Board, N. Y. U. Bureau of Business Research

FIG. 2 RAILWAY TONNAGE AND PRODUCTION IN INDUSTRY

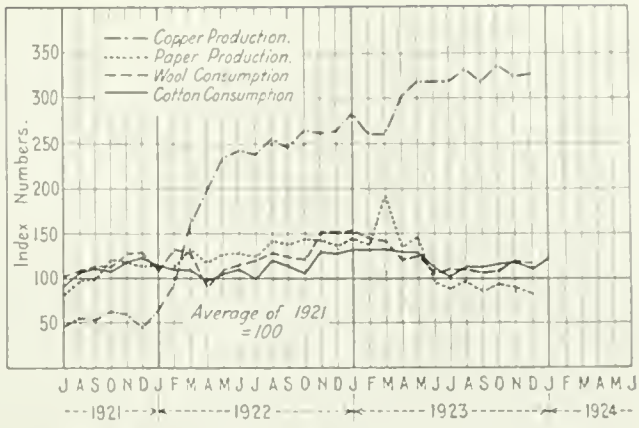
Railway tonnage and production in basic industries corrected for seasonal variation, and the latter also for normal growth.


Unfilled Orders (U.S. Steel Corp.)
Steel Ingots } Avg Daily
Pig Iron } Production
Index Numbers, Unfilled Orders.
Index Numbers, Production.
Average of 1921 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921 1922 1923 1924

Sources, Iron Age, American Iron and Steel Institute

FIG. 3 IRON AND STEEL PRODUCTION AND UNFILLED ORDERS

Corrected for seasonal variation.


Copper Production.
Paper Production.
Wool Consumption
Cotton Consumption
Index Numbers.
Average of 1921 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921 1922 1923 1924

Sources, American Bureau of Metal Statistics; American Paper and Pulp Association; Bureau of Census; Dep't of Commerce

FIG. 4 PRODUCTION IN FOUR IMPORTANT INDUSTRIES

Cotton and wool corrected for seasonal variation.

cent over the December production. The average daily production of steel ingots showed an increase of 17½ per cent during the same month. This verifies our prediction of last month that December would mark the low point in the production of steel ingots.

The data follow:

Average Daily Production (Tons)

	Pig Iron	*Steel Ingots*
Dec. 1923	94,225	113,700
Jan. 1924	97,384	133,300

Unfilled Orders. Unfilled orders of the U. S. Steel Corporation were 8.5 per cent greater on January 31 than on December 31. This is the first increase in the adjusted index of unfilled orders since last April. Unfilled orders of 110 merchant pig iron furnaces as of December 31, however, were 1,126,957 tons, a decline of 12 per cent. This decline was due to increased shipments, and after the unprecedented increase of 105 per cent between October 31 and November 30, gives no cause for alarm.

The pig iron market is active and prices have risen slightly. *The Iron Age* composite pig iron price on December 31 was $21.88 per ton, and on February 11, $22.88 per ton.

TABLE 1. STOCKS OF IMPORTANT COMMODITIES ON THE FIRST OF THE MONTH
(Index Numbers: Average for 1921 = 100)

MONTH AND YEAR	GASOLINE*	LEATHER (Cattle)	ZINC	NEWSPRINT PAPER	AUTOMOBILE TIRES	RAW SUGAR*	COTTONSEED OIL*	MERCHANT PIG IRON	DEPT. OF COM. INDEX OF STOCKS—31 COMMODITIES
	100 = 630,757,000 gals.	100 = 19,742,000 pieces	100 = 77,202 tons	100 = 30,009 tons	100 = 4,364,000 tires	100 = 114,000 tons	100 = 255,400,000 lbs.	100 = 634,950 tons	100 = 139.7
July 1921	103	100.5	116.4	88.7	95.2	109.0	118.5	109.5	101.7
Aug.	109	99.5	119.7	85.0	89.2	77.0	123.0	109.5	97.6
Sept.	108	99.5	112.1	90.4	90.2	87.0	129.5	100.0	93.5
Oct.	109	96.4	105.1	100.8	76.6	116.0	60.0	94.0	93.8
Nov.	102	95.9	91.7	76.7	81.2	69.0	71.0	82.0	94.7
Dec.	102	95.2	86.8	77.1	89.6	96.0	84.0	80.0	93.7
Jan. 1922	103	98.5	78.5	79.8	84.7	95.0	92.0	86.0	95.2
Feb.	110	99.0	85.1	88.5	95.6	88.0	84.0	90.5	92.8
Mar.	110	100.7	83.1	92.7	107.5	136.0	82.0	86.0	90.6
Apr.	110	95.4	78.1	93.9	118.8	183.0	84.0	81.5	89.8
May	110	101.5	67.0	82.9	123.2	140.0	89.0	70.0	85.9
June	111	101.6	52.3	82.6	126.6	105.0	82.0	52.5	76.0
July	114	98.3	38.3	77.9	115.5	107.0	81.0	49.0	74.5
Aug.	123	97.4	37.1	70.5	110.8	151.0	87.5	38.0	73.8
Sept.	133	91.5	28.0	66.3	106.1	132.0	89.0	25.0	71.3
Oct.	146	90.2	24.1	62.7	105.7	122.0	37.0	23.8	76.2
Nov.	161	87.7	23.4	65.8	107.3	70.0	35.0	25.0	88.0
Dec.	160	85.9	25.3	65.4	113.8	55.0	42.0	29.8	88.9
Jan. 1923	156	85.3	23.6	64.0	105.4	55.0	52.0	35.8	89.7
Feb.	156	84.0	21.5	76.7	107.6	76.0	60.0	43.0	84.5
Mar.	154	82.6	14.1	77.3	119.7	86.0	61.5	41.0	79.1
Apr.	162	81.6	13.0	67.2	129.9	168.0	67.0	38.0	78.9
May	164	81.4	11.6	62.9	139.3	147.0	69.0	41.7	73.6
June	173	82.1	16.9	60.5	159.6	97.0	71.0	53.6	72.4
July	174	82.8	22.2	65.0	161.4	97.0	76.0	72.7	72.6
Aug.	185	83.6	27.5	74.0	148.0	96.2	74.0	97.5	73.8
Sept.	199	84.3	34.4	85.5	138.5	81.8	57.4	111.0	75.9
Oct.	206	84.2	29.6	82.2	123.2	130.4	28.0	121.7	80.1
Nov.	211	85.4	33.4	82.4	111.7	102.8	43.0	131.0	89.4
Dec.	202	85.8	40.3	80.0	107.5	89.8	43.3	141.0	88.0
Jan. 1924	...	87.0	47.3	78.8	99.0	79.0	52.5	145.0	
Feb.			52.7						

* Adjusted for seasonal variation.

The steel markets also showed increasing activity during January and *The Iron Age* composite steel price on February 11 was 2.789 cents per lb. Further increases in steel prices are rather likely in view of increased buying.

Conclusion. The demand for iron and steel promises to be well maintained during the first half of 1924, and gradually rising prices are probable. There is strong evidence that the turn in pig iron prices has come, and that supplies for the next six months can be purchased with confidence.

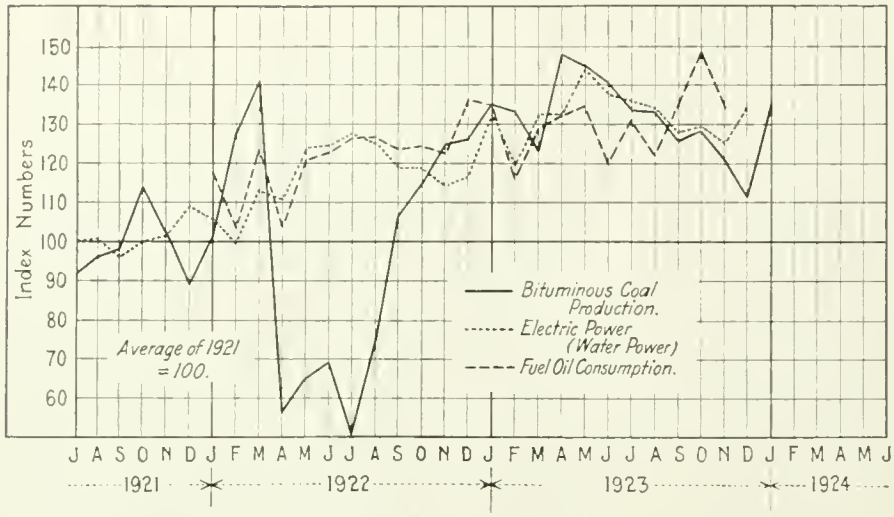
Production in Important Industries

Copper. Copper production during December increased slightly and the index in Fig. 4 shows a gain of 1 point or one-quarter of one per cent. As the stocks of copper are larger, the price has been low. Recently a slight increase in demand has caused greater firmness. The copper industry, however, is not yet in a strong position. Only a few low-cost mines are making profits and there is talk of a duty on copper ore to keep out the Chilean product.

Paper. Paper production decreased 10 per cent during December from the November level, and, though no great improvement in this industry is looked for in the immediate future, the situation is fairly satisfactory.

Wool. Wool consumption decreased slightly (2.5 per cent) during December. The outlook for the woolen industry is slightly better now than six months ago, but it will take some months to bring about an adjustment between high-priced raw material and slow demand for finished product.

Cotton. Cotton consumption increased sharply in January. The figure (576,644 bales) was less than in January 1923, however, and the consumption for the season is lower. Cotton exports also declined to such an extent that the total



Sources, Department of Interior; Bureau of Mines; United States Geological Survey

FIG. 5 FUEL AND POWER PRODUCTION

Bituminous coal and electric power corrected for seasonal variation.

consumption is apparently decreasing. The number of active spindles in January fell off. These facts explain the decline of the cotton market.

Fuel and Power

Coal. Coal production during January showed a large increase, the index in Fig. 5 rising 21 per cent from the December level.

Fuel Oil. No new figures were available at the time this analysis was made.

Hydroelectric Power. Hydroelectric production showed a rise during December of 7 per cent above the output for November, after allowing for seasonal variation. This is partly due to the effect of an unusually mild winter in those states producing much hydroelectric power.

Conclusion. The available data support the evidence that industry is on the up-grade.

Building Activity in January

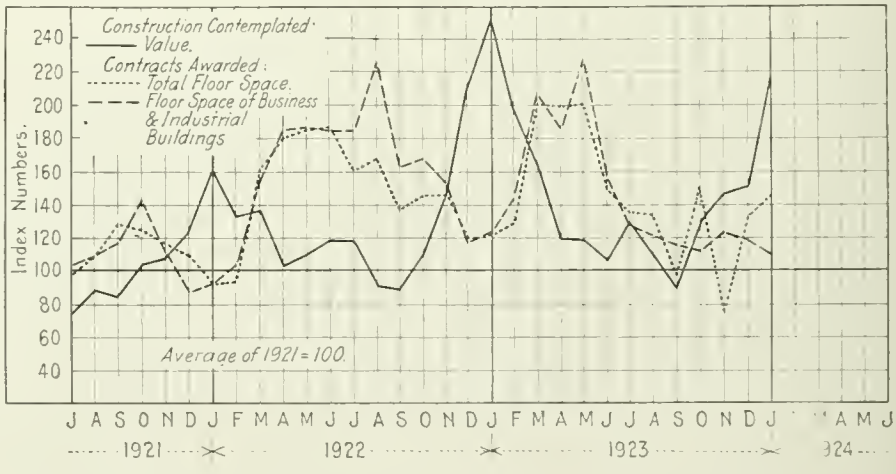
Contemplated Construction. According to the F. W. Dodge Company, contemplated construction for 36 states increased 16 per cent. The index in Fig. 6, which was 131.4 on December 31, rose to 149.5 on January 31, but when these indexes are corrected for seasonal variation they are 151.2 for December and 217 for January, a rise of 44 per cent.

The curve of contemplated construction in Fig. 6, for the past three years has shown similar tendencies and has annually reached a peak in January. From the dull season in September the rise has been abrupt and uninterrupted. In this respect it has followed a course opposite to that of contracts awarded except in the latter part of 1923.

Contracts Awarded. The index of total building contracts awarded rose from 133.2 in December to 144.5 in January, a rise of 8.5 per cent. Contracts awarded for business and industrial building, however, declined from 118.7 in December to 109.2 in January, a decline of 8 per cent.

Conclusion. A large part of the present activity in building is in residential construction, and the trend of contracts awarded for industrial and business buildings has been downward for several months. Construction activity promises to continue on a high level all during the spring. Contemplated construction has risen to a much higher level than was ordinarily expected and forecasts further gains in actual building.

The relative backwardness in business and industrial building may mean a less favorable outlook for demand for iron and steel than would otherwise be the case.



Source, F. W. Dodge Company

FIG. 6 BUILDING CONSTRUCTION AND FLOOR SPACE IN CONTRACTS AWARDED

Construction contemplated corrected for seasonal variation.

Trend of Trade and Finance

Prices Begin Up-trend: Money Firm but Abundant

Exports and Imports

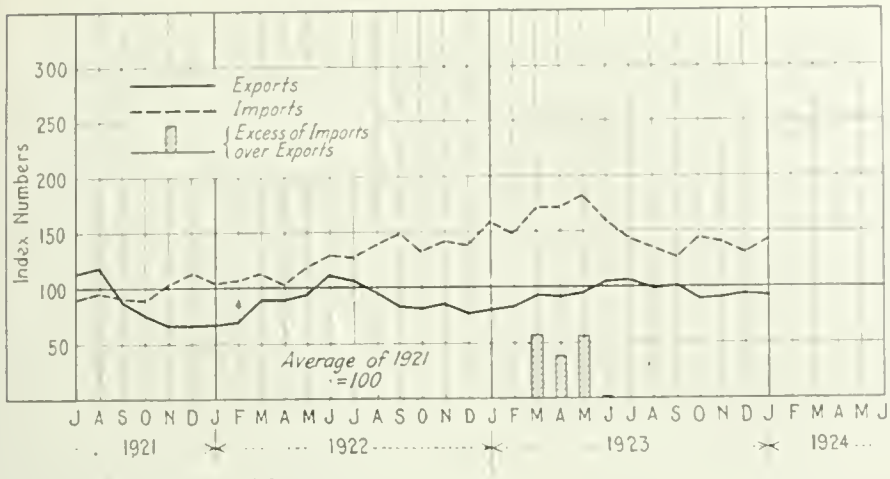
The adjusted index of imports scored a rise from 132.7 in December to 141.6 in January. The adjusted index of exports, on the other hand, recorded a slight decline—from 94.0 to 93.3. (See Fig. 7)

Conclusion. Large shipments of cotton in the past few months have been a major factor in holding up exports. Imports are a sensitive indicator of the business cycle. Their upward movement is reassuring.

New York Stock Exchange

As shown in Fig. 8, the average price of 50 stocks has on the whole advanced since the middle of January. At that time the weekly average was 85.42 while for the week ending February 16, the average was 86.37. The average daily turnover has been over one million shares throughout the period. On the whole, the volume of trading ran parallel to the average price of stocks, which indicates that the market is fundamentally strong.

About the middle of February there was some weakness chiefly occasioned by failure of the public to come into the market in large numbers, and the oil investigation, which was taken advantage of by bear speculators, but the conclusion still holds that the major trend of the stock market will be upward for at least two months. It does



Source, U. S. Department of Commerce

FIG. 7 FOREIGN TRADE OF THE UNITED STATES

Corrected for seasonal variation.

not seem that it can yet have discounted the latest indications of the upward trend of business which are set forth in these pages.

Bank Debits and Postal Receipts

Bank Debits. January debits to individual accounts are usually the highest of the year; but adjustment for normal seasonal variation (See Fig. 9) shows that activity in January 1924 was even greater than the average January experience for the past five years. The January adjusted index rose to 120.8, a gain of nearly 1 per cent over December. (The 1921 average = 100.)

Postal Receipts. The unadjusted index of postal receipts for 50 selected cities, during January, fell about 17 per cent from the December figure. This decline, however, was only a trifle greater than the normal seasonal change during January. Eliminating the usual seasonal change shows a January index of 124.2, compared with the December figure of 124.8—an insignificant decline.

Conclusion. The behavior of these two valuable indexes in January indicates *increased stability in general business conditions, and a slight gain in the total volume of trade.*

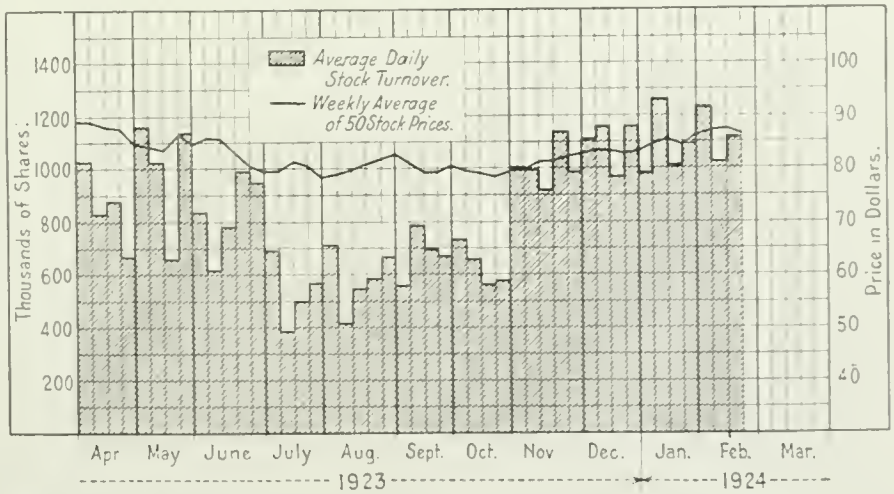
Retail Trade

Mail Order Sales. January 1924 sales of the two leading mail order concerns (See Fig. 10) totaled $20,508,000, as compared with $35,860,000 in December 1923. Inasmuch as this decrease (about 15 per cent) was considerably less than the usual change in January, the adjusted index registered *an 8 per cent gain in activity during January.* The adjusted index for January was 145.7 against 134.5 for December. (The 1921 average = 100.)

Chain Store Sales. The adjusted index of the January sales of four large chain store systems showed a decline of 6 per cent from December. This decrease is not at all serious when it is noted that in the entire period for which statistics on chain store sales are available, January 1924 activity was exceeded only by December 1923.

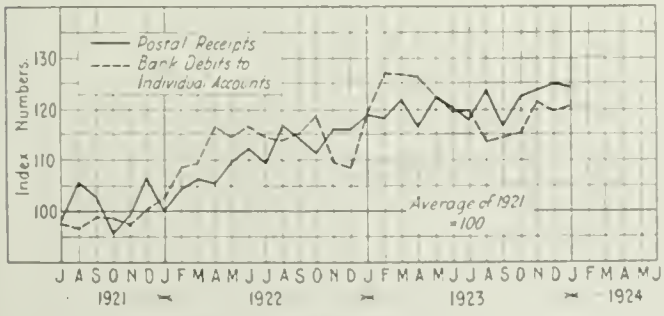
Department Store Sales. After allowing for the average monthly change in the past, the December index of department store sales—the latest obtainable—stands at 115.0 as compared with 111.6 in November, a gain of 3 per cent.

Conclusion. Retail trade is on the upward swing. The large gain in mail order sales is especially encouraging, reflecting as it does *further increased buying in the agricultural Middle West.* The high levels of the other indexes of retail trade are also indicative of great activity, which is a healthy sign.


Average Daily Stock Turnover.
Weekly Average of 50 Stock Prices.
Thousands of Shares.
Price in Dollars.
Apr May June July Aug. Sept. Oct. Nov Dec. Jan. Feb. Mar.
1923
1924

Source, New York Times

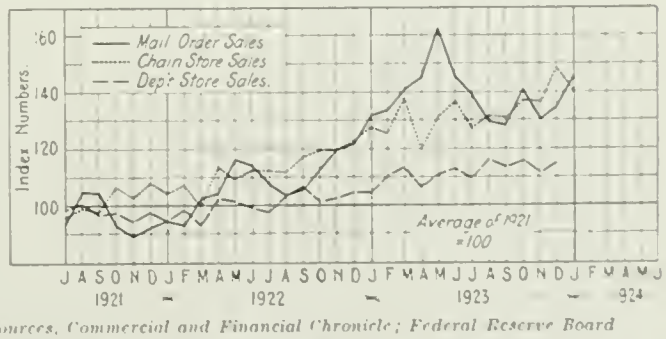
FIG. 8 STOCK TURNOVER AND PRICES ON NEW YORK STOCK EXCHANGE



Sources, Federal Reserve Board; Post Office Dep't.

FIG. 9 BANK DEBITS AND POSTAL RECEIPTS

Both curves corrected for seasonal variation.

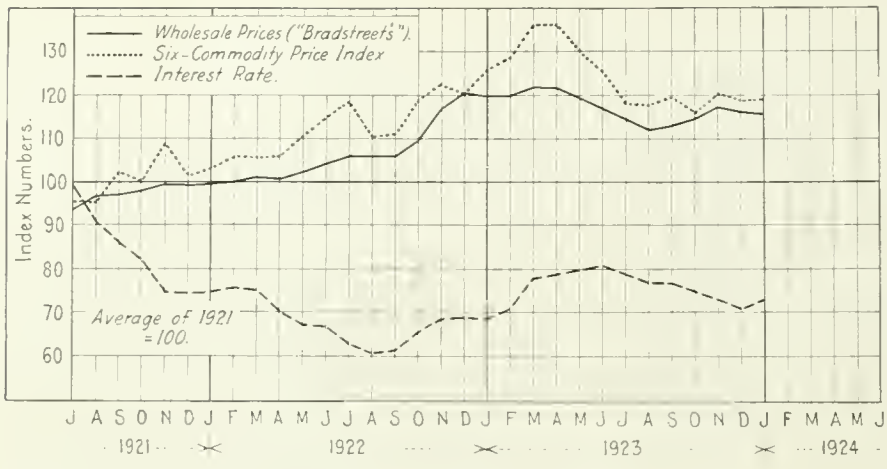


Sources, Commercial and Financial Chronicle; Federal Reserve Board

FIG. 10 SALES OF MAIL ORDER, CHAIN AND DEPARTMENT STORES

Two mail order houses; 4 chain stores; 306 department stores.

Corrected for seasonal variation.


Wholesale Prices ("Bradstreet's").
Six-Commodity Price Index
Interest Rate.
Index Numbers.
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Commercial and Financial Chronicle, Federal Reserve Board

FIG. 11 WHOLESALE PRICES AND INTEREST RATE

Interest rate is the monthly average, corrected for seasonal variation.

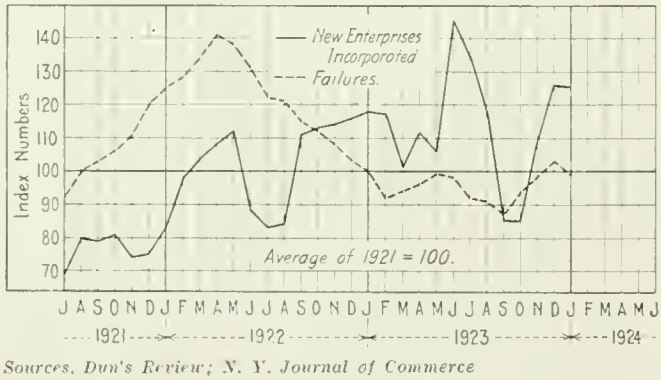
Prices and Interest Rate

Prices. As shown in Fig. 11, there has been no great change in the general level of prices. The sensitive six-commodity index computed by the Bureau, however, advanced slightly during January, rising from 118.9 to 119; and all indexes show a larger number of commodity advances than declines. Dun's index was up on February 1, and the slight decline in Bradstreet's was due to the decline in cotton.

The United States Bureau of Labor's index remained unchanged in January, thus indicating that the recent downward trend in that index has come to an end. The most significant details are as follows: (1) cloth and clothing, and foods decreased; (2) building materials, chemicals, and fuels advanced; (3) metals and metal products were unchanged.

Interest Rate. The curve showing the trend of the interest rate on the best commercial paper moved upward in January. The actual rate remained unchanged at 4¾ per cent; but, as there is usually a decline in January, the adjusted index advanced.

Conclusion. The trend of prices is clearly upward, which is due to increasing demand for commodities and abundant supplies of money and credit. It is probable that the interest rate will soon follow the trend of prices. It seems that money rates have touched the lowest point and are at present firming up. Some time between now and the middle of the year higher rates are to be expected.


New Enterprises Incorporated
Failures.
Index Numbers
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Dun's Review; N. Y. Journal of Commerce

FIG. 12 BUSINESS FAILURES AND NEW ENTERPRISES

Adjusted for seasonal variation; curves plotted as 3 months' moving average.

Business Failures and New Enterprises

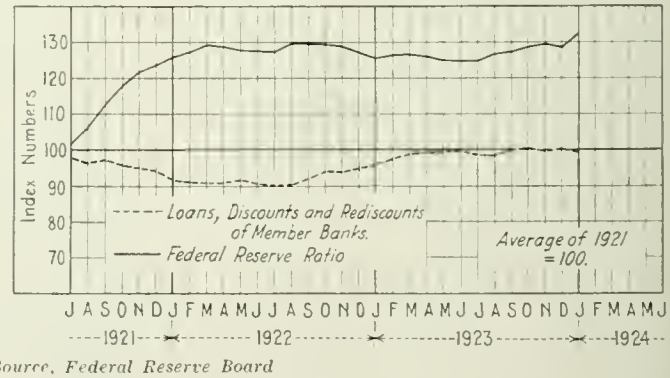
Business Failures. During January the number of business failures increased less than is usual in that month. Consequently, the index shown in Fig. 12, in which the usual seasonal change is eliminated, moved downward. This is the second monthly fall in the adjusted index of business failures. That index is now 94 against 97.1 in December and 94.9 in January 1922. As a result of this change, the three months' moving average shown in the graph decreased.

New Enterprises. On the other hand, the capitalization of new enterprises incorporated decreased in January in spite of the fact that there is usually a gain in that month. This index, however, is very erratic and it will need another month's record before any definite unfavorable conclusion can be based upon its trend.

Conclusion. The decided decrease in business failures is a very favorable indication. It probably marks the end of the late recession.

Bank Credit

Loans and Discounts. As shown in Fig. 13, total loans and discounts of the 760 reporting member banks of the federal reserve system were $11,883,589,000 on January 30. This is a decline of about one-half of one per cent from the previous month.


Index Numbers
Loans, Discounts and Rediscounts of Member Banks.
Federal Reserve Ratio
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Source, Federal Reserve Board

FIG. 13 BANK CREDIT AND FEDERAL RESERVE RATIO

Federal reserve ratio is ratio of total reserves to note and deposit liabilities and has been corrected for seasonal variation.

Federal Reserve Ratio. After eliminating the normal month-to-month variation, the January index of the ratio of reserves to deposit and federal reserve note liabilities combined, rose to 132.5 from the December position of 128.6.

Conclusion. The change in loans and discounts, amounting to less than one per cent, is insignificant. The gain in the federal reserve ratio was largely due to contraction of deposits. A continuation of abundant credit is indicated.

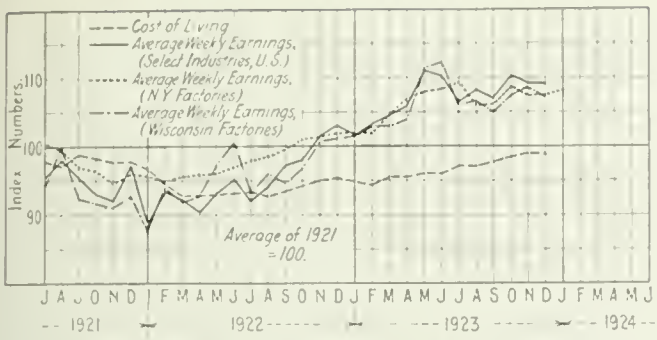
Wage and Employment Situation

Employment Gains: Earnings Stable

Earnings and Cost of Living

Fig. 14 shows the course of average weekly earnings and the cost of living.

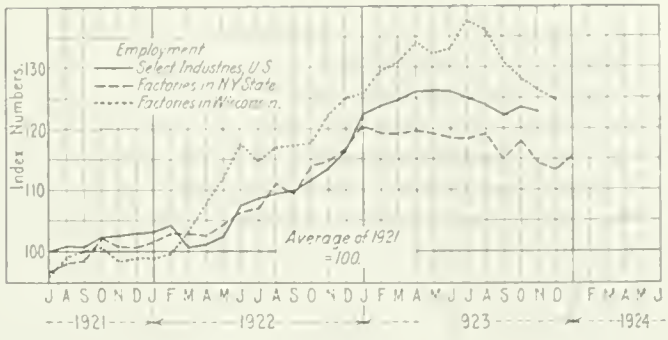
New York Earnings. The seasonally adjusted index of the earnings of factory workers in New York State in-


Cost of Living
Average Weekly Earnings, (Select Industries, U.S.)
Average Weekly Earnings, (N.Y. Factories)
Average Weekly Earnings, (Wisconsin Factories)
Index Numbers
110
100
90
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, U. S. Bureau of Labor Statistics; N. Y. State Dep't of Labor; Industrial Commission of Wisconsin; National Industrial Conference Board

FIG. 14 WAGES AND COST OF LIVING

New York and Wisconsin factories curves corrected for seasonal variation.


Employment
Select Industries, U.S.
Factories in N.Y. State
Factories in Wisconsin
Index Numbers
130
120
110
100
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, U. S. Bureau of Labor Statistics; N. Y. State Dep't of Labor; Industrial Commission of Wisconsin

FIG. 15 THE TREND OF EMPLOYMENT

Corrected for seasonal variation.

creased 0.6 of 1 per cent in January. Actually there was a slight decrease in weekly earnings, but the drop was smaller than is normal at this period.

Wisconsin Earnings. There was a decrease in December of over 1 per cent in the seasonally adjusted index of earnings. The index for December stands at 107.2, the average for 1921 being 100.

Selected Industries in the United States. The index decreased 0.2 per cent in December and stood at 109.4, the average for 1921 being 100. While increases in per capita earnings occurred in most of the industries, there were some large decreases in a number of important industries. (See Fig. 16)

Cost of Living. The cost of living index was practically unchanged in December.

Conclusion. After a decrease in December, the trend of labor's earnings is now slightly upward. The margin between the average weekly earnings of labor and the cost of living has not been materially reduced. Labor's purchasing power continues high.

The Employment Trend

New York State. In January the seasonally adjusted index of employment went up about 2 per cent to 115.4 (See Fig. 15). Actually there was a slight decrease in the number employed, but the decline was not so large as is usual during the let-up in production after Christmas activity.

Wisconsin. The adjusted index declined to 124.9 in December. It is still high, however, being about 20 per cent above any month in 1921 and higher than any month in 1922 except December.

United States. The index of employment in the United States advanced more than one per cent in January after adjustment for seasonal variations. At the present time employment throughout the country is being maintained at a very satisfactory level. It is 20.6 per cent above the average for 1921, and has shown but little tendency to lag during the past two months.

The most notable gains in January occurred in iron and steel, leather, paper and printing, chemicals, and land transportation vehicles.

Conclusion. January reports show a general increase in employment after allowance has been made for the usual changes of the season. Usually January is a month of considerable unemployment and not active in industry, but this year although there were fewer persons employed than in December the slackening has been less than formerly. The labor situation indicates the inherent sound position of business at present. Employment is good and wages are high, thus maintaining the purchasing power of the country's largest group of consumers.

Employment and Earnings in Selected Industries

Fig. 16 shows the trend of per capita earnings and the numbers employed in

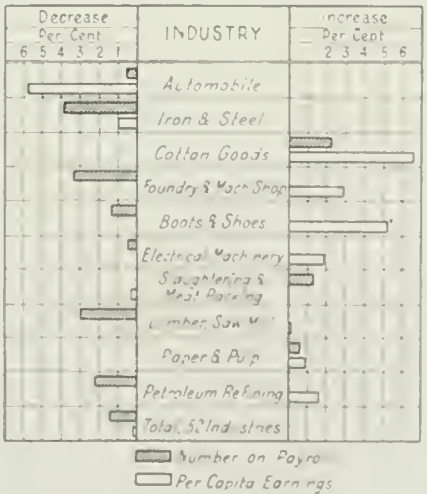


FIG. 16 TREND OF EMPLOYMENT AND EARNINGS, DECEMBER 1923

ten of the leading industries of the United States during December 1923.

Employment. On the whole there was a decided drop in employment in December. Seven of the ten industries analyzed in the chart showed decreases, ranging from 0.5 per cent in electrical machinery to 3.9 per cent in the iron and steel industry, a decrease of 3.4 per cent was recorded in foundry and machine shops, and one of 3.0 per cent in saw mills. Both of these had also shown decreases the previous month, as did petroleum refining which was 2.3 per cent lower in December.

Increases in employment were registered in cotton goods manufacturing (2.2 per cent), slaughtering and meat packing (1.3 per cent) and paper and pulp (0.6 per cent).

For the total of 52 industries the decrease was 1.5 per cent.

Per Capita Earnings. Seven of the ten leading industries showed an increase in the per capita earnings of employees. For two (boots and shoes, and cotton-goods), the increase was in excess of 5 per cent each. In petroleum refining and electrical machinery it was close to 2 per cent. Automobile manufacturing alone showed a notable drop, amounting to 5.8 per cent. In the entire 52 industries reported by the Department of Labor there was a small decrease in per capita earnings of 0.2 per cent.

Immigration and Emigration

The trend of immigration is again upward, as shown by the following table:

1923	*Immigration*	*Emigration*	*Net Gain*
Sept.	89,431	6,073	83,358
Oct.	88,028	7,291	80,737
Nov.	92,782	6,925	85,857

Evidently the supply of labor from this source has gained substantially, especially on the Atlantic coast.

Two wheel trucks, four wheel trucks, trailers, lift trucks—all become Better Trucks when equipped with Hyatt roller bearings.

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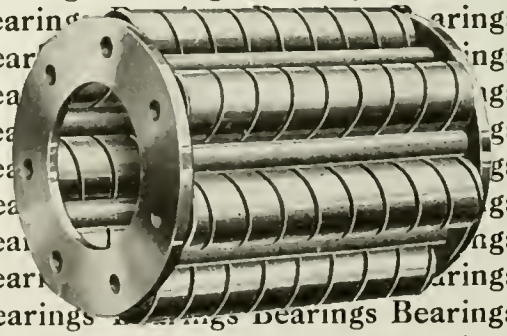

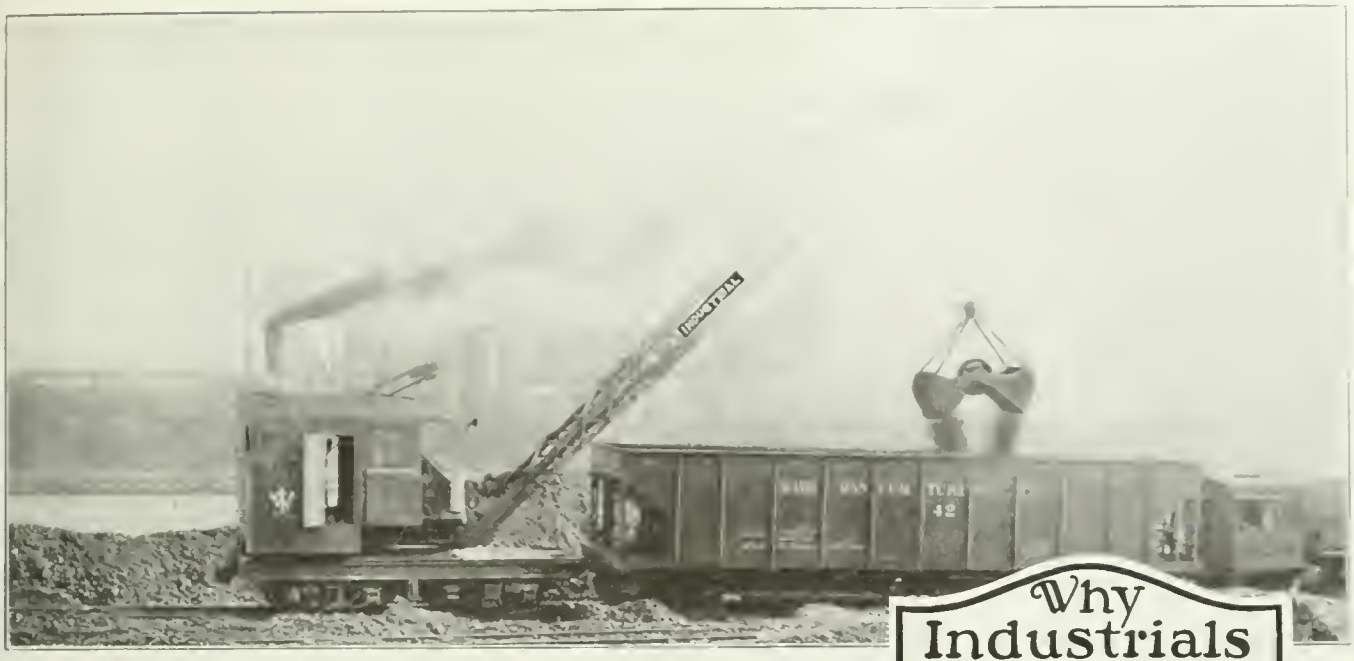

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Why Industrials Excel

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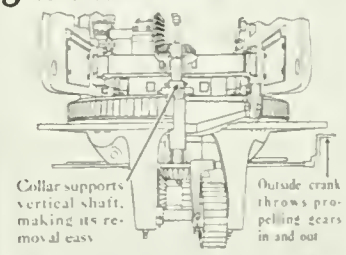
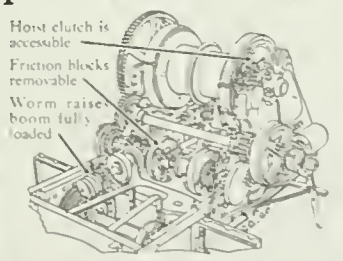


Unit type baseplate supports all propelling mechanism on heavy lugs cast integral with it. There are no bolted brackets or bearing caps to work loose and none of the propelling mechanism is supported by the structural framework of the car

4 HIGHLY ACCESSIBLE MACHINERY



Framework is of heavy castings bolted together with turned bolts. Bearings for all principal shafts are located on the outside of the side frames, where they are readily accessible. All important gears have cut teeth and all bearings are bronze bushed

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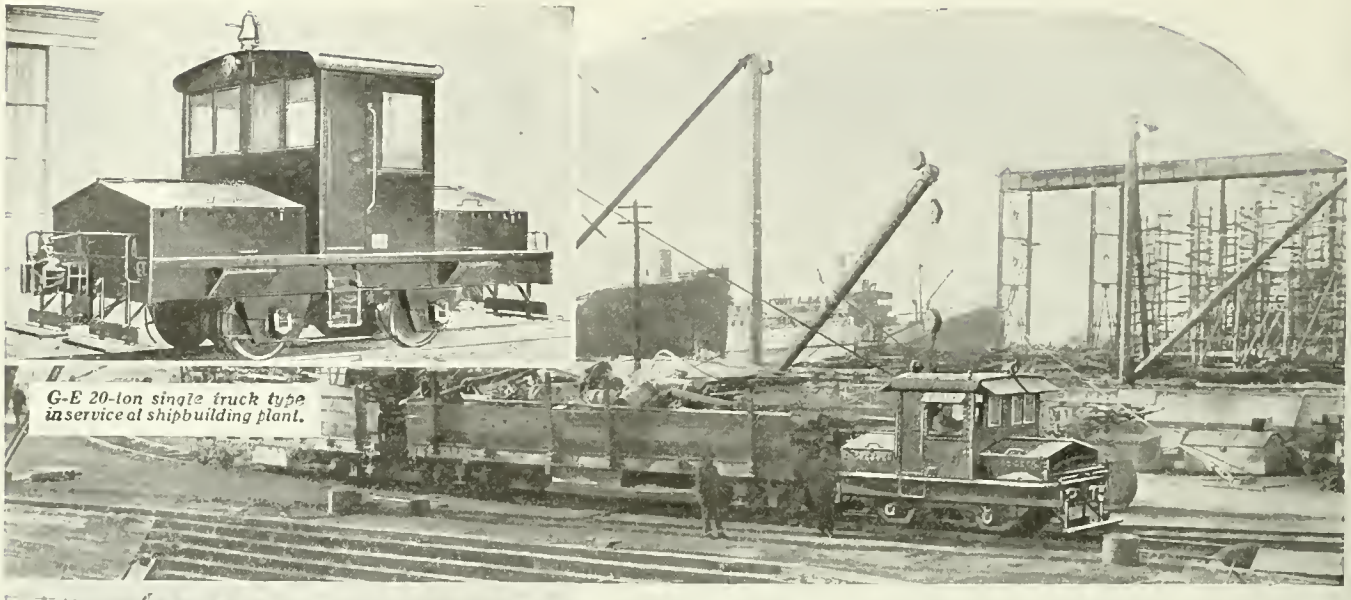
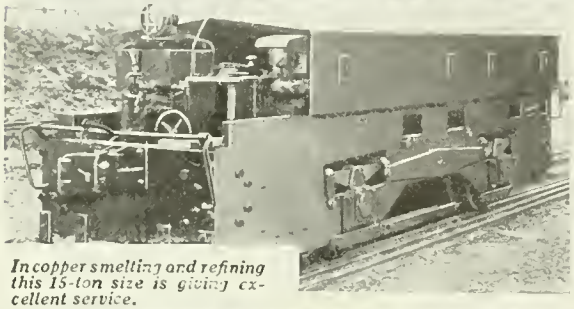
Railway Pile Drivers -- Combination Crane Pile Drivers -- Transfer Tables
Portable Rail Saws -- Grab Buckets -- Magnets -- Steam Pile Hammers

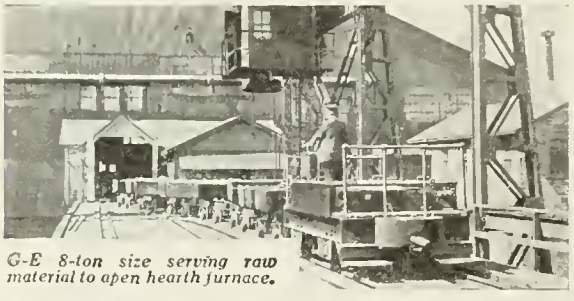
INDUSTRIAL LOCOMOTIVE CRANES



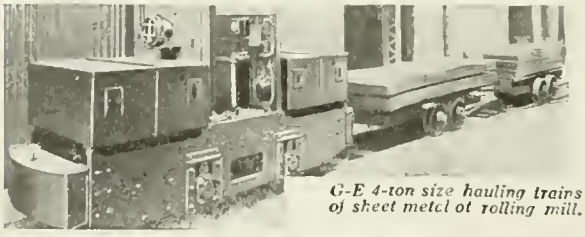
G-E 20-ton single truck type in service at shipbuilding plant.



In copper smelting and refining this 15-ton size is giving excellent service.



G-E 8-ton size serving raw material to open hearth furnace.



G-E 4-ton size hauling trains of sheet metal at rolling mill.

G-E 5-ton type hauling ash trains from power plant to dump pile.

Where G-E Storage Battery Locomotives Are Used

Shipyards—Steel Plants—By-Product Coke Plants—Ore Docks—Chemical Plants—Brick Yards—Stone Quarries—Cement Plants—Docks and Warehouses—Power Houses (ash handling).

These are some of the many industrial users who find in G-E Storage Battery Locomotives an essential and efficient method of haulage—to prevent congestion in the use and handling of its materials, and to speed up production.

The material handling problems cannot be covered by general recommendations. The haulage conditions of each plant should be studied so specific recommendations can be made as to correct weight of locomotive and battery capacity needed to best meet the particular service involved. Upon your request, G-E engineers will gladly study your haulage problem and recommend suitable haulage equipment.

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MANAGEMENT AND ADMINISTRATION

VOLUME VII MARCH, 1924 NUMBER 3

Organizing Industry for Preparedness Against War

By DWIGHT F. DAVIS

Assistant Secretary of War

Index Number
355.21 Industrial preparedness
658:353.6 Management methods in the War Dept.

SUCCESS in modern war depends fundamentally upon four things: morale; money; men; and munitions. A war can be won only when men are intelligently backed up by the other three fundamentals. Congress has made it the duty of the Assistant Secretary of War to prepare plans in time of peace for the mobilization of industry in time of war. The subject is vast and complex, but I am glad to give the readers of MANAGEMENT AND ADMINISTRATION a bird's-eye picture of the steps that have been taken and are proposed in this work of preparedness against war.

Dwight F. Davis

American industry and the American public are fundamentally opposed to war and resort to force of arms only when peaceable means fail to serve the cause of justice and the necessity for self-preservation. At the same time, few industrial managers need to be convinced of the vitally important part which preparedness for war plays in preserving peace, where the citizens of the nation so prepared are level-headed and intelligent, and have an unquestioned reputation for integrity, fair dealing, and love of peace.

The preparedness plans of the United States government now under development by the War Department, are exactly similar to those laid in every well-run business to provide for emergencies which are likely to arise. Compensation, fire, and shipping insurance; employee training; investigations to discover sources of labor, equipment, and materials, which can be relied upon in cases of sudden demand; transportation and warehousing facilities, are but a few of the many subjects listed on the preparedness schedule of all manufacturing plants. Hence, in making comprehensive plans for national defence when war is thrust upon the nation, the government is doing merely what each sound business organization takes care of as part of its usual routine. Throughout all of the activities there is pre-eminent the objective that preparedness shall be the preventative of war.

Men in industry are thoroughly familiar with the fact that manpower on the field of battle is of no avail without arms, ordnance, munitions, equipment, and an endless variety and tremendous quantity of supplies, transportation facilities, and devices for communication. All of these positively must come from the manufacturing plants of the country and originate in its raw materials resources. Where foreign nations are relied upon either for finished products or the materials from which they are made, a very real element of uncertainty and danger is introduced.

In the serious effort to prepare the United States to defend its territory and the rights it must be privileged to exercise if it shall remain a free and unmolested nation, the War Department is asking the hearty co-operation of every branch of industry and every individual business, mining, manufacturing, transportation, and intercommunication en-

terprise. Many of these have already lined up, through their respective associations, with the preliminary plans made thus far. From now on activities will be concentrated on working out and transmitting to local plants, through their district headquarters, information and data which will enable them immediately to go on a war production basis when the message comes that their services are needed.

In the first place, a survey is being made to determine just what war products each plant can most efficiently turn out, and the possible rates of production. Comprehensive information has already been compiled showing in detail exactly what the army will require at each successive stage of its mobilization and for each increase in the forces as recruited and organized. After the particular military supply output of each plant has been agreed upon with its chief executive, he will be supplied with a standard form of contract, plans, drawings, specifications, and definite instructions, all to be carefully preserved by him until he receives instructions to sign and forward the contract and start production.

The standard form of contract is practically completed. It provides definitely for the kind, quality, quantity, inspection, and delivery of the products to be made, the plan and rate of payment to be adopted and the adjustment of any emergencies and misunderstandings which may unexpectedly arise. The drawings, specifications, and special instructions will be standardized and will conform to the best industrial practice, to avoid delay in interpreting them.

While the work of compiling the lists of military requirements and the preparing of contracts forms, drawings, and specifications can all be accomplished by the War Department, the survey and arrangements with manufacturers must be undertaken throughout each military district by the co-operation of industrial leaders. This involves time and personal sacrifice. However, men are cheerfully and energetically lining up for this work, and experiences during the World War leave no doubt that American industry can be relied upon to do everything within its power for the defense of the nation. Industrial economy is severely shaken during and after a war, and, as one of the best assurances against warfare is complete industrial preparedness, industrial executives see at once that in backing up the present great program they are taking the most positive steps to maintain peace and foster the life and growth of their own business interests.

Hence, in the management of each enterprise, by conference with trade and technical associations and by direct contact with the War Departments through various district headquarters, manufacturers will be asked to co-operate by developing their industrial facilities. Some thought can be given to the selection and training of employees so that they will be not only proficient in their various trades during peace times, but also able to swing over into the occupations falling to them in time of war. This calls for an organization analysis and a personnel distribution such that no work shall be disrupted either by the necessary shifting of employees in time of war or the unnecessary drain by enlistment for active military service of those skilled workmen who cannot be replaced in industries essential to insure an uninterrupted flow of munitions.

Utilization and layout of equipment can be studied profitably so that a change over to war conditions will involve the least adjustment. Purchase of new apparatus, when made during the course of trade growth, should include consideration of a possible military emergency. Perhaps even proposed new buildings, and especially the routing and transportation of materials in process, ought to be viewed in the light of wartime conditions.

The other important item of production is raw materials. The investigations of the War Department are being pushed to determine where and in what quantities these are obtainable. When the domestic supply is to be found inadequate or non-existent, both the relative security of foreign sources and the development of substitutes procurable in this country are being carefully considered. American industries must be assured an unrestricted flow of materials, and the steps taken to accomplish this for war periods are certain to result in a vast economic advantage during times of peace.

There is no thought of persuading plants to go to additional expense purposely to develop personnel, equipment, or materials under the preparedness program. But in future commercial operations industrial executives will be urged to have war needs in mind.

The matter of financing is not being neglected. Plans for payment upon delivery of product will include provisions for facilitation of operations where money considerations hold back a plant from starting much-needed production. Similar aid was given to industrial establishments during the past war.

The World War cost far more in men and money than it would have entailed had the United States been working under a preparedness plan like the proposed comprehensive system. Hence, present taxes are higher than they would have been if the nation had been organized for a military emergency. The War Department program, therefore, will effect tremendous national and hence industrial savings during, and after, any future conflict. Exactly what this means may be better comprehended by our experience in the World War. During the last ten months of that conflict, the average daily cost of the war (not including ordinary expenses of government, or loans to the allies), was $44,000,000. Industrial preparedness which will shorten a war by one day represents therefore a saving to the taxpayer of nearly $2,000,000 every hour.

Moreover, the work of the War Department, if cooperated in heartily by industry, has such vast possibilities in the way of management developments, through the impetus given to the organization, utilization, and control of finances, men, machines, and materials, that enormous savings in every line of activity will result. This in turn will increase industrial earnings and assist in preserving our high standard of living against any possible inroads of foreign competition.

Industrial preparedness will do more than any material effort, single or combined, to prevent a future war. It will go further. It will powerfully stimulate the march of national progress and the spreading of American ideals of justice and peace.

Pricing Policy in Relation to Financial Control

Tuning Up General Motors—Article Three

By DONALDSON BROWN

Vice-President, General Motors Corporation

Index Number
658.14 Financial control
338.85 Price analysis

THE enunciation of a basic policy to govern questions of plant extension greatly furthers the orderly control of fixed investment. If this is definitely tied into the pricing policy the result is a systematic co-ordination between fundamental considerations that are inevitably interwoven.

To illustrate, suppose that a basic policy has been established to the effect that plant capacities, on the basis of practical annual output, shall be maintained at 125 per cent of the *judged average trend volume*, (the margin being deliberately preserved to take care of peak requirements). Then the accepted normal average rate of operation is instantly fixed at 80 per cent of the practical annual capacity. If a given plant operated at an actual average rate below 80 per cent then there is excess investment in capacity pronounced unnecessary by the terms of the established policy.

Establishment of Standard Volume

It will be found from a description of the method which follows, that the establishment of a percentage representing an assumed normal average rate of plant operation is an essential factor in the analysis of price. This determines the so-called standard volume which is accepted as the basis upon which costs will be measured, and upon which the margin of profit is determined as necessary to afford a given average rate of return upon capital employed. The established percentage must reflect the unavoidable fluctuations of business which render an even rate of production impossible, and as far as practicable should represent the economic situation of the industry, rather than any abnormal situation which might be recognized as pertaining to a given plant. For example, the operation of a given plant at a lower rate than competing plants leads to higher costs and increased margin of profit necessary for a given rate of return on fixed investment. Thus the establishment of a percentage that is below the average rate at which competitive plants actually operate tends towards inflation of prices above a proper economic level. Therefore, if excess capacity exists by reason of a previous misconception of the intrinsic position of the industry, or if an individual plant operates at subnormal rate, or suffers fluctuations of volume of greater magnitude than normal, resulting from misjudgment of competitive conditions or other cause, no warranty is supplied for modifying a percentage established as representing normal average rate of operation. In any such case a lowering of the established percentage would tend to intensify rather than to improve the condition.

On the other hand, if it be judged at any time that the reasonable expectations with respect to fluctuations of volume normal to the industry are of greater or less magnitude than admitted by the terms of the established policy, then the established percentage should be modified correspondingly.

Obviously it is not possible to predetermine the actual contour of a production curve, and the assumption as to the normal average rate of plant operation is a matter of judgment. So, also, is the question as to the *economic return attainable*. Prices might be maintained to yield 20 per cent average return on capital on the assumption of plants operating at an average of 80 per cent of practical annual capacity, and time might prove actual operation at an average of 65 per cent and the return 15 per cent. It would not follow necessarily that, had the actual operating condition been foreseen, 20 per cent return could have been attained. The two questions are necessarily associated, and the basic pricing policy should reflect reasonable allowances for unavoidable fluctuation of volume, requiring that the *economic return attainable* be stated at all times upon the basis of an accepted conception of the normal average rate, or attainable average rate of plant operation. This will be expressed as a percentage of practical annual capacity, and will be known as *standard volume*.

The foregoing has dealt with the principles involved in the price consideration. The following deals more concretely with the method of analysis designed to give reflection to these same principles.

Influence of Volume Fluctuations on Costs

Costs of production and distribution per unit of product must vary with fluctuation of volume, because of the uncontrollability of some of the expense items. Ordinarily, raw materials and productive labor may be referred to as 100 per cent variable, as the aggregate will vary with volume, and remain uniform per unit of product except for price changes. Among the uncontrollable items are such expenses as depreciation, taxes, etc., which may be referred to as 100 per cent fixed, since within limits of capacity the aggregate will not change, but, per unit of product, will vary indirectly with volume.

There will be a group of items, partially controllable, as to which there is no exact means of determining the degree of variation, and with respect to these it is practicable to approximate the condition by applying

a factor of variability that will afford a reasonable allowance for variation in the aggregate due to changes in volume.

Generally speaking, within the limits of existing capacity, the influence of volume falls upon the final *unit cost* of product in the following way:

1. *Raw Materials and Productive Labor*—Generally unaffected by volume.
2. *Manufacturing Expenses*—Affected by volume in varying degree, according to the character of the various expenses involved, as for example:
   (*a*) *Fixed expenses* (such as depreciation, taxes, etc.), amount per unit of product affected in indirect proportion to volume.
   (*b*) *Partially controllable expenses* (such as light, heat, power, salaries, etc.) Amount per unit of product affected by volume according to the degree of variability. A factor of variability to be adjudged and applied to the current aggregate expense of the group, to arrive at the portion considered as 100 per cent variable. The remaining portion will be considered to be "100 per cent fixed".
   (*c*) *Controllable expenses* (such as inspection, handling of material, etc.). Amount per unit of product unaffected by volume.
3. *Commercial Expenses, in Distribution and Administration*—Affected by volume in varying degrees according to the character of the various expenses involved, as for example:
   (*a*) *Fixed Expenses* (such as main administrative salaries, rents, etc.) Amount per unit of product affected in indirect proportion to volume.
   (*b*) *Partially Controllable Expenses* (such as salesmen's and other salaries, traveling expenses, etc.) Amount per unit of product affected by volume according to the degree of variability. To be treated with as mentioned in section above under manufacturing expense.
   (*c*) *Controllable Expenses* (such as loading and shipping commissions, etc.) Amount per unit of product unaffected by volume.

As unit costs are affected by fluctuation of volume, it is not practicable nor desirable to alter selling prices so as to maintain a uniform profit margin. The normal average of manufacturing expense, and distribution and administration expenses should be estimated. These, added to the raw material and productive labor cost will give an applicable total cost on an estimated normal average basis. The pricing of product should be in relationship to costs on the normal average basis, arrived at in this manner.

Treatment of Manufacturing Expenses

Manufacturing expenses are absorbed in factory costs through a burden account. If the burden rate is altered from month to month, so that the actual expense is absorbed at all times, the consequence is a distortion of costs and of inventory values due to the effect of fluctuating volume. The more acceptable accounting practice is to apply a standard burden rate, representing the proper absorption of burden at standard volume. In periods of low volume, the unabsorbed manufacturing expense is charged against profits as "unabsorbed burden," while in periods of high volume the overabsorbed manufacturing expense is credited to profits as "overabsorbed burden". In the interests of co-ordination it is important that standard volume for purposes of burden absorption shall coincide with standard volume for purposes of price analysis.

TABLE 1. ILLUSTRATES THE GENERAL PRINCIPLES OF ACCOUNTING PROCEDURE

	Actual Current Condition	Per Cent of Standard Volume	Estimated Condition at Standard Volume
Production, Units	55,000	137.5	40,000
Productive Labor	$8,250,000	137.5	$6,000,000
Manufacturing Expenses:			
(*a*) Fixed Expenses	$2,000,000	100	$2,000,000
(*b*) Partially Controllable Expenses	9,325,000	122.7	7,600,000
(*c*) Controllable Expenses	550,000	137.5	400,000
Total Manufacturing Expense	$11,875,000	118.75	$10,000,000

To arrive at the burden rate which is to be applied according to the foregoing purposes careful analysis must be made of the character of manufacturing expenses, with a view to determining the portion which is of non-controllable character. The various items should be allocated respectively to the three groups (*a*), (*b*), and (*c*) as set forth in the foregoing. As to groups (*a*) and (*c*) there is no difficulty in arriving at the non-controllable expense; the whole of class (*a*) is non-controllable, and class (*c*) holds no non-controllable expense. The degree of variability of class (*b*) has to be estimated in the light of operating experience, and it is important to keep a close follow-up analysis of this so that errors of assumption or of estimate may be corrected promptly.

The hypothetical case, Table 1, may illustrate the general principles of accounting procedure.

It will be supposed that burden in this instance is being absorbed on the basis of productive labor. It is estimated that at standard volume the total aggregate manufacturing expense would be $10,000,000, and that the productive labor would be $6,000,000, thus giving a standard burden rate of 166 2/3 per cent. This burden rate would be applied, as a charge to factory cost, and with operations at 137.5 per cent of standard volume the overabsorbed burden would be $1,875,000 as follows:

Productive Labor at Current Production	$8,250,000
Burden Absorbed at Applied Burden Rate 166 2/3 per cent	13,750,000
Actual Manufacturing Expense	11,875,000
Overabsorbed Burden	$1,875,000

This amount would be credited to operations through an overabsorbed burden account. In this way the

factory cost of product, as accounted for, is not affected by fluctuations in volume of production.

Commercial expenses are charged off from month to month against operations, and there is not involved the question of distortion to asset value in consequence of fluctuating volume, as in the case of manufacturing expenses. Therefore there is no need of any special accounting procedure such as that described in the foregoing. In the consideration of price, however, it is just as important to analyze the non-controllable character of commercial expenses, and to allow for the same on the basis of a normal average operating condition.

It is customary to allow for commercial expenses as a percentage of sales. The following hypothetical case, Table 2, may illustrate the general way in which this is given consideration:

In this case the allowance for commercial expenses would be 7 per cent of sales, that being the estimated condition at standard volume, representative of a normal average operating condition.

TABLE 2. ILLUSTRATES THE GENERAL WAY TO ALLOW FOR COMMERCIAL EXPENSES AS A PERCENTAGE OF SALES

	Actual Current Condition	Per Cent of Standard Volume	Estimated Condition of Standard Volume
Volume of Sales—Units	55,000	137.5	40,000
Volume of Sales—Amount	$68,750,000	137.5	$50,000,000
Commercial Expenses:			
(a) Fixed Expenses	$1,600,000	100	$1,600,000
(b) Partially Controllable Expenses	1,525,000	117.3	1,300,000
(c) Controllable Expenses	825,000	137.5	600,000
Total Commercial Expenses	$3,950,000	112.9	$3,500,000
Per Cent of Sales	5.75		7.0

The rate of capital turnover is usually the most important factor in a price consideration, since the margin of profit in relationship to this determines the rate of return upon capital. It is always important to maintain a statistical analysis of capital employed serving as an indication of normal capital requirements for a given volume of business, and at the same time as a basis upon which the effectiveness of control over the various investment items may be gaged.

Generally speaking, except that there may be seasonal fluctuations, the amount of capital tied up in working capital items should be directly proportionate to the volume of business. For example, the raw materials on hand should be in direct proportion to the manufacturing requirements, so many weeks' supply of this material, so many weeks' supply of that material, and so on, depending upon the condition and location of sources of supply, transportation conditions, etc. Work in process should be in direct proportion to the requirements of finished production, being dependent upon the length of time required for the material to pass from the raw to the finished store, and the amount of labor and other charges absorbed in the process. Finished product should be in direct proportion to sales requirements. Accounts receivable should be in direct proportion to sales, being dependent upon terms of payment and efficiency of collections. Capital tied up in plant and other fixed assets is, of course, fixed investment, and should be considered in its relationship to factory cost of production.

TABLE 3. SHOWS STANDARDS OF CAPITAL REQUIREMENT IN TERMS OF THEIR RESPECTIVE RATIO TO ANNUAL SALES OR ANNUAL FACTORY COST OF PRODUCTION

Investment in Plant and other Fixed Assets	$15,000,000
Practical Annual Capacity	50,000 units
Standard Volume, Per Cent of Practical Annual Capacity	80 per cent
Standard Volume Equivalent	40,000 units
Factory Cost per Unit at Standard Volume	$1,000
Annual Factory Cost of Production at Standard Volume	$40,000,000
Ratio of Investment to Annual Factory Cost of Production	0.375

TABLE 4. SIMILAR STANDARDS ESTABLISHED FOR WORKING CAPITAL REQUIREMENTS

	Normal Average Requirements		Standards of Capital Requirement	
	In Relation To	Turnover per Year	Ratio to Sales *Annual Basis*	Ratio to Factory Cost *Annual Basis*
Cash	Sales	20 times	0.050	
Drafts and Accounts Receivable	Sales	10 times	0.100	
Raw Material, and Work in Process	Factory Cost	6 times		0.16⅔
Finished Product	Factory Cost	12 times		0.08⅓
Gross Working Capital			0.150	0.250
Fixed Investment	Factory Cost			0.375
Total Investment			0.150	0.625

Standards of capital requirement should be established, representative of a normal average operating condition, in terms of their respective ratio to annual sales or annual factory cost of production according to whichever is the more direct relationship. The hypothetical case, Table 3, may be taken as an illustration.

This ratio represents the *Standard* of capital requirement for fixed investment.

Similar standards are established for working capital requirements, as illustrated in Table 4.

Base Price Stated as Percentage of Factory Cost

The basic pricing policy is expressed in terms of the economic return attainable. This must be interpreted, in terms of price, and enunciated as the *base price*.

Prices of product should change, in the absence of extraneous considerations, with changes in raw material and labor prices. The base price should be considered in relationship to cost on the normal average basis. Therefore, as previously stated, the total cost should be estimated on such basis by including with the actual raw material and productive labor cost an allowance for the normal average of uncontrollable or partially controllable expenses. In order to allow for freedom of action with respect to variations in raw material and labor prices, it is not desirable to establish the base price in terms of dollars per unit of product, but rather in terms of percentage of factory cost on the normal average basis.

Assuming *Economic Return Attainable* of 20 per cent as the expression of policy, and employing the

standards developed in the foregoing hypothetical cases, the following summary, Table 5, will illustrate the method of price analysis:

TABLE 5. SUMMARY ILLUSTRATING THE METHOD OF PRICE ANALYSIS

	Standards	
	Ratio to Sales *Annual Basis*	Ratio to Factory Cost *Annual Basis*
Gross Working Capital	0.150	0.250
Fixed Investment	.....	0.375
Total Investment	0.150	0.625
Economic Return Attainable—20 Per Cent	.....	.....
Multiplying the Investment	.....	.....
Ratio by this, the Necessary Net Profit Margin is Arrived at	0.030	0.125
Standard Allowance for Commercial Expenses, 7 Per Cent	0.070	.....
Gross Margin Over Factory Cost	0.100	0.125 per cent
Selling Price, as a Ratio to Factory Cost	$\frac{1+b}{1-a}$ =	$\frac{1+0.125}{1-0.100}$
Equals	—1.250	

Thus it is found that to derive a return of 20 per cent per annum on capital employed, the net selling price must be 1.25 times the factory cost. Therefore, Base Price Net to Company—125 per cent.

If there is an average commission to dealers of 20 per cent, the list price at retail would be:

$$\text{Base Price, List, } \frac{125.}{0.80} = 156.25 \text{ per cent}$$

Thus the base price is stated as a percentage of factory cost (on the normal average basis). There will be no change by reason of fluctuating volume and consequent variation in cost. With no change in the assumed economic return attainable, as representing the basic pricing policy, the base price will remain constant unless there is a change in assumed capital turnover.

Base Price in Relationship to Actual Price

The *base price* represents a pronouncement of basic policy, and should be applied in continuing comparisons with actual prices. For example, with a *base price* of 125 per cent applied to a factory cost of $1000 per unit an indicated selling price of $1250 is arrived at to accord with the pronounced policy. This indicated selling price will be referred to as the *base price equivalent*. General correspondence between prices thus indicated and actual prices established from time to time demonstrates a state of co-ordination between the pronounced policy and administrative practice, and affords a verification of an expectancy of a given average rate of return upon capital employed. Lack of correspondence, however, does not necessarily constitute a deviation from policy. Production costs are likely to vary continually to a minor extent and selling prices ordinarily cannot be adjusted frequently, so that in establishing selling prices it is necessary to make allowances for estimated tendencies in production costs over a period of time within which a readjustment of selling prices would not be desirable. Moreover, this method of price analysis itself is such as to reflect the desirability at times of pricing product above the *base price equivalent* and at other times below.

It follows, therefore, that at a given time it is not necessarily desirable that the established price shall be in precise agreement with the *base price equivalent;* but it is essential to interpret a lack of agreement as to whether the causes are such as neither to constitute a deviation from policy nor to indicate an erroneous expectation of rate of return attainable on capital employed. An admitted deviation from the pronounced policy requires either a correction of the established price, or a revision of the assumed *economic return attainable.*

Modification of Base Price

Contact with actual operating conditions might point to errors of assumption as to normal average rate of plant operation, average capital requirement, and other assumptions and estimates employed in the basic pricing policy. Furthermore, the *base price* will be subject to modification from time to time as the assumed *economic return attainable* may be influenced by a composite of such considerations as the following:

1. Nature of the business, and its state in the progress of development up to what is usually called the point of stabilization.
2. Degree of difficulty in the way of the industry meeting a continued growth in demand, due to limitation of capital and other causes.
3. Productivity of capital in the industry and the influence of rate of return upon price, and the susceptibility of demand to price variation.
4. Availability and economic cost of capital in the case of the individual business.
5. Advantages over existing or latent competition in point of average capital turnover, and in production and distribution costs.
6. Peculiar circumstances having to do with satisfaction of demand and which are unrelated to capital turnover.
7. Good-will in the business.

(To be concluded in the April issue.)

A PRECEDING article on "Pricing Policy in Relation to Financial Control" by Donaldson Brown, appeared in the February number of MANAGEMENT AND ADMINISTRATION. In this first article Mr. Brown outlined the organization of General Motors and the conditions confronting it, gave a brief picture of the forecast scheme through which the Finance and Executive Committees are kept informed and in position to control, then takes up the company's theory of pricing, i. e., "to gain over a protracted period of time a margin of profit which represents the highest attainable return commensurate with capital turnover and the enjoyment of wholesome expansion, with adequate regard to the economic consequences of fluctuating volume. Thus the profit margin translated into its salient characteristic rate of return on capital employed is the yardstick by which to gage the price of a commodity with regard to collateral circumstances affecting supply and demand". The article concludes with a consideration of all the factors and conditions involved in the fixing of prices. —THE EDITORS.

Underfeed Stokers and Economy in Coal*

Development, Operating Principles, and Applications to Power Production

By JOSEPH G. WORKER

Assistant to the President, American Engineering Company; President, Stoker Manufacturers Association

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stokers

THE problem in fuel burning is not entirely one of selecting the thermally most efficient system. We must consider, in addition, other elements that are connected with a combustion system as vital factors in the ultimate results.

Flue gas temperatures, preheated air, and hollow wall construction are among the things that can affect the overall efficiency of a combustion system from 5 to 10 per cent. These are not a part of any particular combustion system, but, in our endeavor to find the apparatus that will give the best results from a dollar and cents basis for a particular installation, great care must be taken to see that outside influences do not work against the attempt to secure the greatest economy.

The mechanical stoker, more than any other piece of boiler-room equipment, has made possible the present size of boiler plants and the rate at which fuel is now so efficiently burned and utilized. It has also formed the basis upon which we are now installing a boiler hp. for 6 kw. generator capacity, where 15 years ago we installed a boiler hp. for 2 kw. generator capacity.

There have been and there are many types of stokers involved in this development, and among them the underfeed stoker has figured very prominently. In order to find out to what extent it is now used to burn Midwest coal, figures were sought, with the following results:

A little over 1,000,000 hp. of boilers were sold in the United States, during the year 1922, by 28 boiler companies. About 800,000 hp. of all types of stokers were sold. Of the 800,000 hp. of stoker-fired boilers 550,000 hp. were equipped with one type or another of underfeed stoker, about 200,000 hp. were equipped with some type of chain-grate stoker, and about 50,000 hp. were equipped with some type of overfeed stoker. That is, about 75 per cent of the stokers sold in the United States during the year 1922 were underfeed stokers.

From the most nearly exact figures I am able to obtain, based on a knowledge of the sales of large underfeed stoker manufacturers, the indications are that there were more underfeed stokers sold in the West during the year 1922 than any other type of stoker. There are perhaps as many going into the West as into the East. While these sets of figures throw some light on our subject they are perhaps expressive of economic conditions and not of differing measures of efficiencies in combustion systems.

We may have been correct in the past in holding that no stoker handles all grades of coal with the same degree of satisfaction. In that thought, however, we have considered mechanical operating difficulties that were not at all a part of the fuel-burning system, but were quite distinct from the process of cleaning a fuel bed.

There have been two types of stoker designers. One had tendencies towards building a machine that would offer the best combustion possibilities, irrespective of the cleaning device. Others have mixed the problem to the extent of designing stokers that may not have been the most efficient in so far as burning coal was concerned, but which handled clinkers so well that a sacrifice of combustion efficiency was allowable.

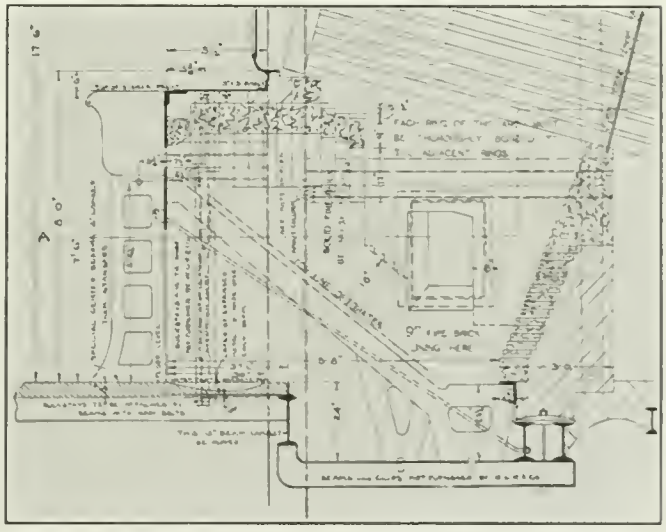

FIG. 1 ROney STOKER SETTING OF FORMER TYPE

We have heard many times that the underfeed principle was all right for Middle West coals but there was too much clinker trouble. In a number of cases this statement, when accepted without analysis, prevented stoker manufacturers and users from looking beyond the trouble into combustion results, in order to determine what should be done to overcome it without disturbing the primary combustion system.

Years ago the East went through a similar process when the development of the underfeed principle was being taken up by certain power stations. Some could see the virtue of the system when it was first developed, but it gave rise to almost endless discussion. As a result, the most severe tests were brought to bear upon the combustion systems in existence at that time. Nothing could stop this movement after it was once

* From an address delivered before the Chicago Section of the American Society of Mechanical Engineers.

started. Improvements were made on one part after another of the controlling mechanisms, but the underfeed method of burning coal, probably more than any other single element, was responsible for the success of the whole system.

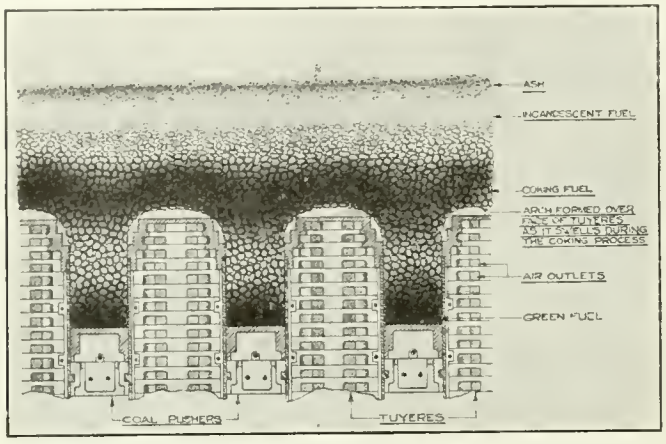

FIG. 2 DIAGRAM SHOWING UNDERFEED METHOD OF FUEL BURNING

Fig. 1 shows a setting, now obsolete, of a Roney stoker in the East. The Interborough Rapid Transit Company had many of these settings of 600 hp. boiler capacity with a 12 ft. 7 in. furnace width. As the illustration shows, the distance of the front boiler header from the floor line was 7 ft. 6 in. and in some cases 8 ft. A battery of these boilers was about 30 ft. wide. The distance from the stoker to the boiler tubes was only about 5 ft. The units are now replaced by underfeed stokers. The underfeed stoker still goes in the 12 ft. 7 in. furnace width, but gives 4800 hp. instead of 900 hp. While this is over five times the capacity in maximum rating, in so far as coal burning is concerned, the boilers installed had only double the previous capacity, being 1200 hp. normal rating.

We sometimes forget that newest stoker developments started in the West, but in a number of cases the problem was never finally and definitely worked out before some other part of the country took it up. As coal conditions in the new locality were not so severe, the stokers were developed for this other market, and no further effort nor money was spent in making a particular stoker adaptable to western coal conditions.

A clear idea of the principles involved in the fuel bed of a multiple retort underfeed stoker is an important consideration. An endeavor has been made to bring out some of the ideas of Elwood Taylor, the inventor of this type of stoker, in a sketch of an underfeed fuel bed, Fig. 2. A review of some of the inventor's claims when he petitioned for patents on this device particularly brings out the movement of the fuel. Many have the idea that an underfeed fuel bed is agitated and the fuel is pushed across the supporting structure from the point where it enters to its discharge as ash.

The inventor stated that in the operation of his stoker the fuel bodies in the several retorts constituted legs of a single fuel bed. This fuel bed burns with the incandescent fuel on top and the coking fuel underneath, extending back into the retorts. The fuel bed receives its support from the walls of the retort and, owing to the cohesion and arching properties of the fuel as it swells during the coking process and is fed outwardly by the retort pushers, it is kept substantially free from the tuyere faces by arching over them, as shown in Fig. 2. The sketch also shows very plainly the partially coked coal extending into the retorts, and an endeavor has been made to bring out clearly the arches over the tuyeres. This operating principle and the claims of the inventor have been demonstrated by research work to be sound, and have also been substantiated by expert engineering testimony.

Few have considered that underfeed stokers use arches in the combustion process similar to the way chain-grates and other stokers use refractory arches. These underfeed arches are made up of partially burned coal and are continuously being burned up and reformed. Immediately over the arches of partially burned coal comes the incandescent and major fuel bed extending across the openings of the retorts. Finally, the fine ash floats on top of the entire fuel bed. See Fig. 3. These particles of ash are small, and originally independent pieces. The feed of ash is a gravity feed down the slope of the fuel bed and its movement is induced by the introduction of cartridges of fuel. These cartridges introduced periodically give a weaving movement to the fuel bed and an outward feed movement across the mouth of the retort.

Very often the idea is advanced that the agitation of underfeed fuel beds is not good practice with a high ash coal. A careful analysis of underfeed fuel beds will show, however, that there is little agitation or mixing of the fuel bed of the kind generally supposed. The injection of the cartridges of fuel is so gradual

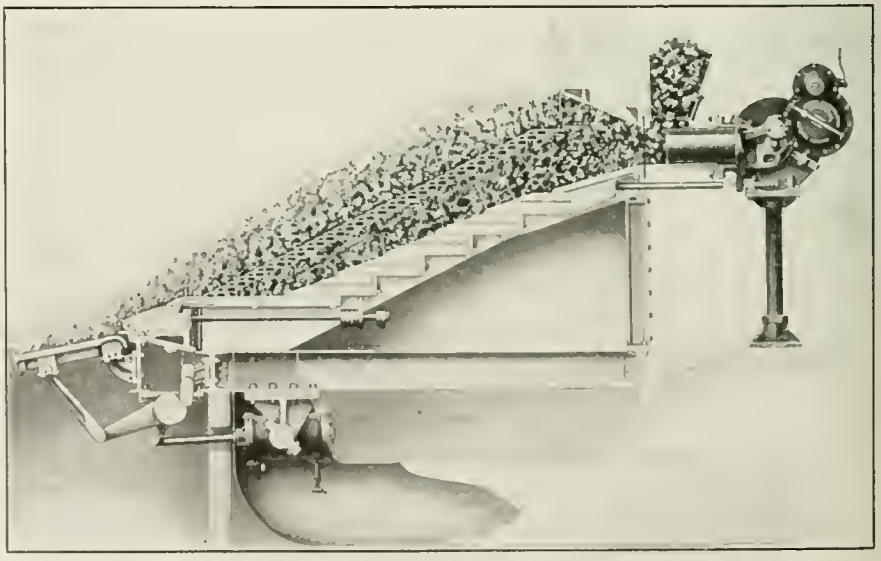

FIG. 3 CROSS-SECTION OF TYPICAL UNDERFEED STOKER

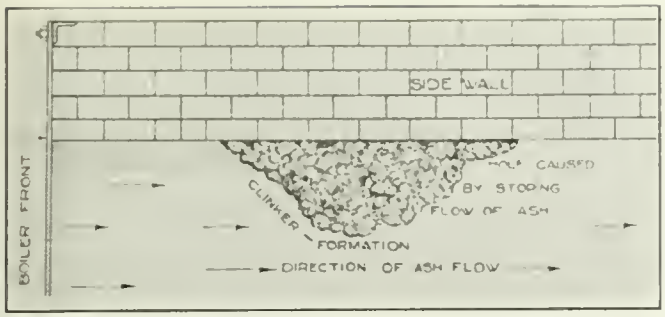

FIG. 4 METHOD BY WHICH CLINKERS FORM

that the movement at the time the coal is introduced is hardly perceptible to the eye. Arching of the fuel in the retort also relieves the pressure on the portions of the fuel in contact with the coal pushers when they retract for another charge of fuel, so that fuel movement is always outward.

In its operation the underfeed stoker is thus to be distinguished from those forms of mechanical stokers

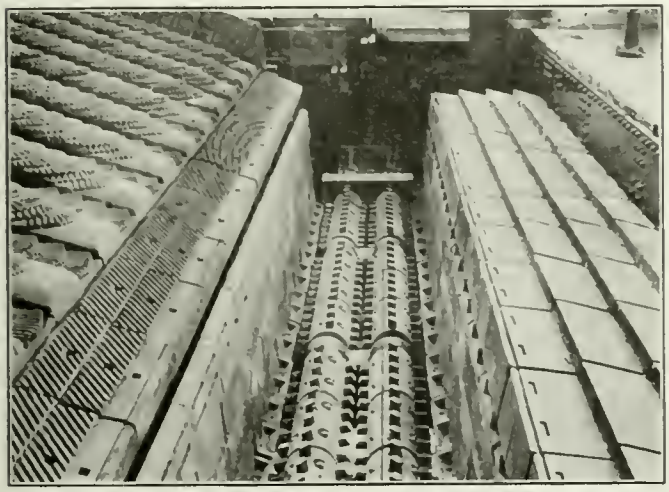

FIG. 5 ROTARY ASH DISCHARGE MECHANISM OF UNDERFEED STOKER

employing inclined grates in which the feed of the green fuel is an overfeed, along the slope of the grate, and produced by a movement of the grate bars. No grates or fuel supports, such as employed by overfeed or chain-grate stokers, are used in underfeed stokers, the fuel instead being supported by the retorts.

The formation and progress of the ash of an underfeed fuel bed is generally misunderstood. There is no progressive movement of ash through an underfeed fuel bed by pushers or rams. The feed of the ash is a gravity feed down the slope of the fuel bed, induced by the feed of the green fuel, and the inclination of the fuel bed must be such that the ash will travel in this manner.

Having developed the principles of a proper fuel burning process, have we given enough thought to the machinery necessary to allow the fuel bed to function according to its principles? If there were no side walls, bridge walls, nor other refractory parts surrounding an underfeed stoker, and nothing to retard the flow of ash from the top of the fuel bed to the bottom, would clinkers form?

Take for example, a particle of ash in a fuel bed, as shown in Fig. 4. When stopped in its course down the slope, this particle adheres to the side wall and backs up the oncoming ash, commencing the formation of clinkers. The obstruction will gradually grow until it is built out into the fuel bed, and underneath it, and in some cases down into the retorts, unless it can be started on its course again.

The development work done on furnace construction for underfeed stokers has brought out side-wall air plates, air-cooled crusher plates, water-backs, and other devices, all to keep the ash from stopping in its course down the fuel bed. Side-wall air backs are now being generally used in connection with underfeed stokers. These plates are working very satisfactorily and, of course, are much better than the refractory material that was previously used.

If we assume that the progress of the ash is not stopped but that the particle continues down the slope of the fuel bed, the next obstruction it meets is the bridge wall. When multiple retort underfeed stokers were first installed they were equipped with dump grates, and unless this part of the stoker was handled properly, the flow of ashes stopped at the bridge wall and a gradual accumulation and backing up of ash soon resulted in large clinkers that not only lay on the dump grates but built up into the fuel bed.

Without violating the underfeed fuel bed principles, the designers tackled this problem and the result was what is commonly termed the rotary ash discharge, shown in Fig. 5. This device is very necessary for continuous and uninterrupted progress of ash and clinker from underfeed stoker fires. It is obvious that under certain conditions of operation it is not necessary continuously to actuate the crusher in the ash well, and hence it is operated to synchronize with the formation of ash as it proceeds down the slope of the fuel bed. Air backs and water backs are used on the

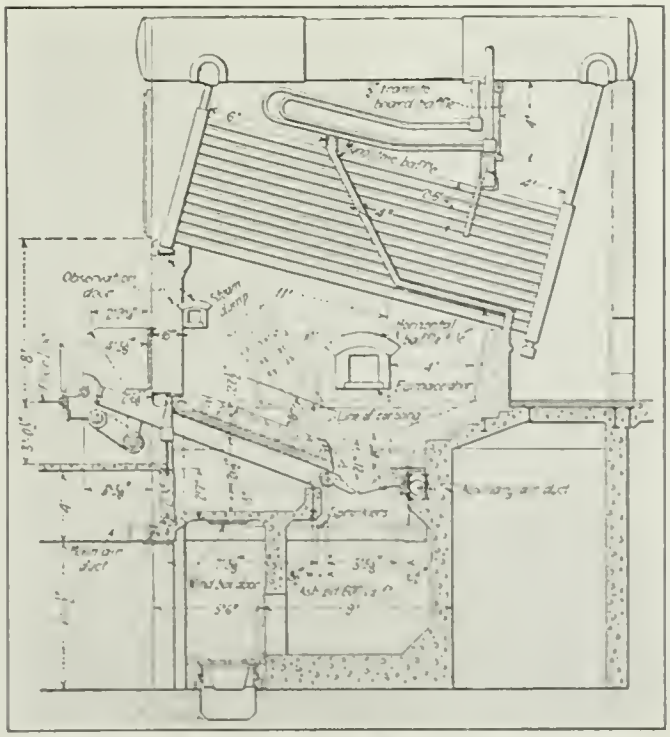

FIG. 6 TYPICAL UNDERFEED STOKER INSTALLATION

front face of the bridge wall to prevent the stopping of any ash or clinker in its course down through the ash wells through the crusher rolls into the ash pit.

Today, in the West, some of these clinker problems are being solved and we no longer fear clinkers. At least, we are not avoiding underfeed stokers just because western coals clinker. In support of this statement, I will refer to a number of practical installations of underfeed stokers in the West to give an idea of what is being done.

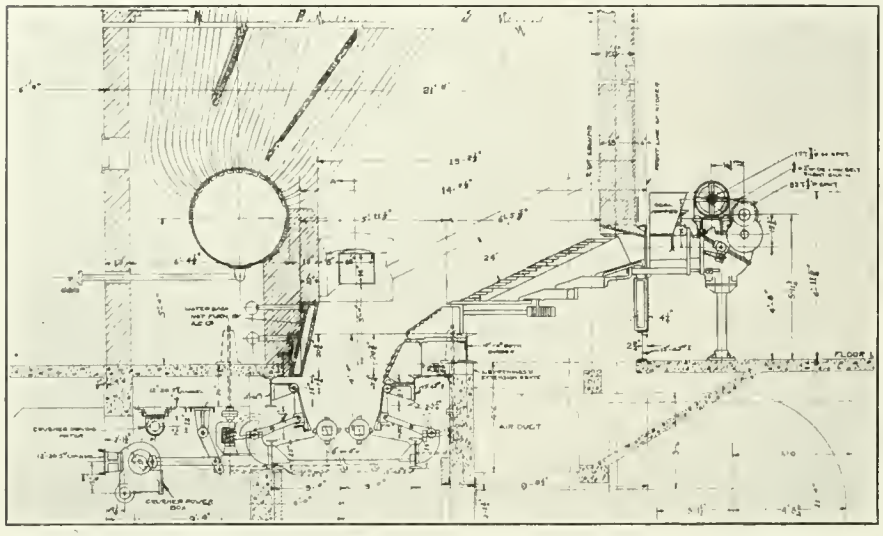

FIG. 7 UNDERFEED STOKER WORKING EFFICIENTLY WITH LOW-GRADE COAL

The Minneapolis General Electric Company, operated by H. M. Byllesby Company, was probably one of the first stations in the Northwest to install underfeed stokers. The earliest stokers were installed under twelve 600 hp. boilers in 1913. The next extensions were installed in 1917, under 1300 hp. boilers. The latest installation covers underfeed stokers under 1800 hp. boilers with the use of rotary ash discharge. The H. M. Byllesby Company have also installed underfeed stokers in the plants of the Oklahoma Gas and Electric Company, and Louisville Gas and Electric Company, Louisville, Kentucky.

The Twin City Rapid Transit Company, of Minneapolis, supplies current to electric railway systems and operates in parallel with several hydroelectric plants. A few years ago it was decided to increase the capacity of the boiler plant and to improve its flexibility and economy. In view of the kind of coal being used, which was Northern Illinois coal, time and thought were given the underfeed stoker to work out the problem of continuous and satisfactory operation. It was established in the beginning that the underfeed method of burning coal was to be used and a trial underfeed stoker was installed. Work was done on this trial stoker until the results sought were obtained. After that many more underfeed stokers were installed. See Fig. 6.

The United Light and Railway Company, of Grand Rapids, Mich., controlling properties in Davenport, Fort Dodge, Cedar Rapids, Mason City, Iowa (Fig. 7), and Moline, Illinois, changed over their combustion system in 1912, and since then have been installing underfeed stokers. The new $10,000,000 plant at Moline, Illinois, will be equipped with underfeed stokers. A poor grade of Iowa coal is being used in most of these plants and the rotary ash discharge is being employed.

In 1913, there was published the results of underfeed stokers at the plant of the Kewanee Works of the National Tube Company, now the Walworth Manufacturing Company. The feature of this installation was the use for the first time of the Taylor stoker with Illinois coals. At that time very high efficiencies were obtained with Illinois coal averaging about 9700 B. T. U. That was 11 years ago. The average operating results of this plant for 9 years were published not long ago, and as a matter of interest are reviewed here. See Table 1.

The boilers shown in Fig. 6 were also operated with coal of a similar kind and B. T. U. content. An operating capacity of 350 per cent of boiler rating was obtained. Efficiencies ranged from 77 per cent at normal rating to 60 per cent at 35 per cent of rating. Considering the variable load and the low-grade of coal (16 to 22 per cent ash, and 3.5 to 5 per cent sulphur) this performance was very creditable.

My idea in mentioning these stations in the West that are using low-grade, high-ash coal with underfeed stokers, is to bring out the fact that we are getting over our fear of handling clinkers on any kind of a stoker. I do not believe that we have exhausted our resources in this respect. My belief is that we should leave the fuel bed alone, since it is established that the underfeed principle is an efficient fuel burning method, and devote more thought and effort to taking care of conditions that such a fuel bed establishes, changing the furnace, or bridge wall, or any part of the whole installation that is necessary, to get the practical operating results which mean economy.

TABLE 1. KEWANEE WORKS BOILER-ROOM RECORD

Average Operating Results Since 1914

	YEAR								
	1914	1915	1916	1917	1918	1919	1920	1921	1922†
Water evap. per month, 1000 lb.	20,000	19,740	26,920	29,960	27,060	31,180	31,450	20,470	26,300
Coal consumed per month, 1000 lb.	3,100	3,075	4,132	4,657	4,420	4,548	*5,652	3,240	3,898
Boiler hours per month	.....	1,556	1,330	1,457	1,463	1,698	1,770	1,233	1,419
Average steam pressure, lb. gage	117	118	121	150	165	166	162	162	167
Average f.w. temperature, deg. fahr.	202	200	197	188	191	192	195	199	197
Average superheat, deg. fahr	78	81	85	84	80	74	85	75	79
Average per cent rating device	.....	88	106	109	98	97	103	87	97
Average B.T.U. per lb. coal as fired	10,130	9,830	9,880	9,950	9,920	9,990	9,650	9,400	9,818
Average efficiency, per cent	67.9	70.0	71.1	70.5	67.5	67.5	68.4	72.7	75.0
Average flue gas temperature, deg. fahr	405	407	435	449	456	454	475	437	434
Average NaCl concentration in boilers, gr. per gal	328	329	354	339	337	352	300	258	255

*Includes coal equivalent of a small percentage of oil burned.
†January to August.

Operating Factory Divisions by Budget

Control Through Organization and Budgets—Article Four*

By THOMAS B. FORDHAM and EDWARD H. TINGLEY

Superintendent, Delco-Light Co. *Engineer, Delco-Light Co.*

Index Number
658.14 Financial control
658.16 Organization

THE successful operation of a budget system of control depends to a great extent upon the ability of the management to enlist the co-operation of every division head and department foreman. While these executives may be willing to estimate expenses for a future period, unless they co-operate to the fullest extent to keep expenses within the budget, the real purposes will be defeated, namely, to control every part of the business to secure the most economical operation.

There has been too much tendency in the past conduct of business to expect the head of a division to operate his departments efficiently without giving him an opportunity to learn the results he obtains. Experience has abundantly proved that the more a division head knows about the details of expenses and costs in his division, the better qualified he will be to reduce them. This knowledge has a broadening effect, causing him to see the relation of his division to the others, and to understand the many items that enter into the operation of a business which determine whether or not a profit will ultimately be realized. Every executive should be a business man in addition to knowing the details of his own division.

A previous article has described how the comptroller uses the budget figures to study the general trend of the business. It is equally essential that each division head also be provided with data so that he may analyze his estimated and actual expenditures and secure a real control over his departments. To do this it is necessary that as soon as possible after the close of every budget period, the comptroller shall provide a comparison of the estimated and actual expenses for the various items appearing on the budget. This must be not only in bulk figures for the division as a whole, but also broken down into departmental costs and expenses. The data must be compiled in a manner similar to Table 13, giving the controllable, semicontrollable, and uncontrollable expenses for the divisions.

With these figures before him, the division head can quickly see where the actual expenses exceed the estimated, and can institute an investigation to determine the reason. Take, for instance, the spoiled work or scrap item which may have been estimated at $5,000 whereas the actual value amounted to $10,000. To trace down this excess properly it is necessary to secure a report from the cost department on the cost of scrap by departments, and then to call in the respective foremen to explain their excessive amounts. As a basis for determining what are high and low percentages of spoiled work, it may be necessary for a committee of executives and foremen to set standard percentages for each department of the factory, after carefully analyzing the tools and equipment and class of labor employed. This standard and equipment will be used in estimating future budget amounts. The same is true of perishable tools and general supplies, which will be found to bear a direct relation to the schedule of production.

The value of such analyses and records far outweigh their cost. Tabulating machines and similar accounting devices make possible in many offices today the compilation of an increased number of reports heretofore gathered by clerks at great expense. Mechanical sorting broadens the possibilities of the cost department, and makes available, to wide-awake executives who will use it, much hidden information.

TABLE 13. MONTHLY DEPARTMENTAL EXPENSE REPORT

.....*Department* .....*192*..

Nature of Expense	Estimated Last Month	Actual Last Month	Estimated Allowance for This Month
Salaries			
Indirect labor			
General supplies			
Perishable or small tools			
Traveling expenses			
Maintenance and garage material			
Spoiled work			
Light, heat, power, and water			
Repairs to equipment			
Total Controllable Expense			
Fixed expense charged to floor space (taxes)			
Fixed expense charged on value of equipment (depreciation			
Fixed expense charged on the number of employees liability insurance			
Total of Direct Charges to Department			
Charges or credits from other departments			
Total overhead to be absorbed by department			
Direct labor earnings			
Overhead rate			

Table 14 shows a report on the total labor in the productive departments of a certain large manufacturing company. The indirect labor is further broken down into the component parts as shown in Table 15.

* See MANAGEMENT AND ADMINISTRATION, December 1923, p. 719; January 1924, p. 57; and February 1924, p. 205, for previous instalments.

TABLE 14. LABOR ANALYSIS OF PRODUCTIVE SECTION—EARNINGS FOR WEEK ENDING JUNE 30, 1923

Date, July 10, 1923

DEPARTMENT	PIECE WORK	DAY WORK WITH PRICE	DAY WORK WITHOUT PRICE	REOPERATION	INDIRECT LABOR	TOTAL
Office	$.....	$.....	$.....	$.....	$452.50	$452.50
Machine drill	770.98	2.44	.....	7.30	312.86	1,093.58
Boring mill	525.01	3.35	23.09	6.30	148.59	706.34
Finished grind	599.53	11.89	.54	6.18	179.11	797.25
Gear cutters	62.94	1.08	.....	.....	40.32	104.34
Punch press	655.78	27.08	20.54	38.57	221.00	962.97
Filing	263.07	.88	2.32	35.86	64.36	366.49
Enameling	522.44	35.82	1.44	13.88	258.18	831.76
Rough grind	953.13	.....	2.94	10.93	52.45	1,019.45
Plating	195.13	.....	.....	9.52	42.47	247.12
Mill and drill (men)	732.03	.....	.....	27.58	210.75	970.36
Mill and drill (girls)	489.76	.....	.....	3.11	.....	492.87
Hand-screw (men)	874.38	77.84	9.02	42.12	204.35	1,207.71
Hand-screw (girls)	135.86	6.33	.....	.....	.13	142.32
Automatic	485.30	.....	.....	30.65	660.92	1,176.87
Japanning and lacquering	1,306.62	59.01	.....	25.54	204.44	1,595.61
Heat treating	.....	.....	302.41	19.68	164.90	486.99
Plant assembly (men)	844.88	7.81	14.82	3.90	141.53	1,285.94
Plant assembly (girls)	144.84	4.68	13.73	.80	2.58	166.63
Tin shop	1,294.20	67.21	24.16	168.75	236.60	1,790.92
Armature (men)	667.69	5.05	185.74	93.68	395.42	1,347.58
Armature (girls)	1,269.18	101.54	7.11	17.44	22.03	1,417.30
Cabinet	299.75	4.50	11.03	13.87	193.49	522.64
Accessory assembly	562.09	1.18	251.70	12.38	190.80	1,018.15
Cabinet assembly	357.54	15.45	49.23	122.47	323.37	868.06
Special plant	.....	.....	108.55	32.00	6.66	147.21
Totals	$14,012.13	$433.14	$1,028.37	$742.51	$4,729.81	$21,218.66

Every item on the sheets should be studied and where variations are noted from week to week, the reason should be known. In a business of any great size, the executive or supervisor cannot be in personal touch with all the details of his departments and must therefore have some other means of knowing why the larger items of expense or excessive labor hours exist. It is only in this way that he can expect to exercise real control.

Other items of expense, chargeable to the various departments of the factory, can be covered in monthly reports to the superintendent and supervisors and these are:

1. Maintenance charges
2. Tool repairs
3. Machine repairs
4. New perishable tools

Unless the data in the reports and compilations of costs and labor statistics furnished by the cost department are used in controlling the factory or guiding the policies pursued, it is useless to make these reports. Much valuable information is contained in such figures and if the cost department does not put an interpretation on them some one within the manufacturing division should do so. An analysis should be made periodically of all reports of labor and costs for use by the superintendent and his supervisors, and distinct efforts should be made to utilize the facts presented.

The division head gives to the head of every section under his supervision detailed figures covering the operation of that section. These figures will include not only the estimated and actual totals of expenses for the section for the previous budget period, but a predetermined estimate of the individual expense items as they apply to every department of that section for the coming budget period. These detailed estimates are best prepared by a competent person in the cost department where data are available as to the past expense of each department. Many items will have a direct ratio to the amount of production scheduled for the budget period, and in making up the allowances, to be given each department this fact must be taken into account as well as the semicontrollable and uncontrollable items.

There may be times when the management will find it necessary to reduce the amounts requested by a division head, in order that the business may secure the desired margin of profit. When this condition arises, it is necessary to give to every section head a new set of figures for his department which must not be exceeded during the budget period in question. This may force economies in certain lines, but with the figures to work with it is easy to know where to make the reductions.

Whether the detailed figures of departmental expense should be given to the foremen or not is an open question. Extreme care must be used in the method of passing out facts to subordinate executives regarding the business. Where the foremen are of the highest type and have been proved as to their ability to use such facts to the advantage of their departments, the information can be supplied directly. In any case, however, charts which graphically show trends and relationships are effective means to accomplish the desired results. Fig. 10 is a chart showing the conditions which existed month by month in the productive de-

TABLE 15. ANALYSIS OF INDIRECT LABOR FOR PRODUCTIVE SECTION—WEEK ENDING JUNE 30, 1923

Date, July 10, 1923

DEPARTMENT	SUPERVISION	CLERICAL	MATERIAL HANDLERS, TRUCKERS	CLEANERS, SWEEPERS	JOB-SETTERS	OVERTIME BONUSES	SUNDRY INDIRECT LABOR	TOOLS, MAINT. MISC.	IDLE AND LOST TIME	TOTAL
Office	$.....	$72.50	$.....	$.....	$.....	$.....	$.....	$.....	$.....	$72.50
Machine drill	.....	.....	21.20	42.41	76.30	27.72	94.30	.....	3.43	265.36
Boring mill	.....	.....	17.56	1.25	45.50	31.58	2.55	.....	5.15	103.59
Finished grind	.....	.....	.....	20.00	82.55	22.61	0.27	.....	16.18	141.61
Gear cutters	.....	.....	.....	.....	.....	.....	.....	.....	0.32	0.32
Punch press	.....	.....	5.95	22.64	95.00	4.66	20.10	.....	25.15	173.50
Filing	.....	.....	.....	21.20	.....	2.72	0.32	.....	0.12	24.36
Enameling	.....	.....	.....	25.20	.....	20.21	167.77	.....	.....	213.18
Rough grind	.....	.....	.....	1.81	.....	6.55	1.13	0.46	.....	9.95
Plating	.....	.....	.....	2.95	.....	3.39	34.13	0.65	1.35	42.47
Mill and drill (men)	.....	.....	29.83	.....	90.88	5.41	37.13	.....	.....	163.25
Hand-screw (men)	.....	.....	.....	23.40	124.60	9.28	2.07	.....	.....	159.35
Hand-screw (girls)	.....	.....	.....	.....	.....	.....	0.13	.....	.....	0.13
Automatic	.....	.....	20.00	20.00	195.72	10.90	167.84	.....	201.46	615.92
Japanning and lacquering	.....	.....	22.50	20.00	106.30	3.31	0.27	.....	4.56	156.94
Heat treating	.....	37.80	.....	.....	.....	30.09	7.96	39.05	.....	114.90
Plant assembly (men)	.....	40.30	.....	.....	31.85	79.20	213.18	.....	.....	364.53
Plant assembly (girls)	.....	.....	.....	.....	.....	.....	2.58	.....	.....	2.58
Tin shop	.....	32.50	.....	20.00	.....	0.26	30.00	105.98	0.36	189.10
Armature (men)	.....	26.40	.....	.....	75.35	.....	101.17	.....	.....	202.92
Armature (girls)	.....	.....	20.00	.....	.....	.....	1.28	.....	0.75	22.03
Cabinet	.....	.....	8.80	.....	.....	5.64	3.90	94.15	.....	112.49
Accessory assembly	.....	.....	18.40	.....	.....	4.95	87.21	32.51	0.23	143.30
Cabinet assembly	.....	.....	33.07	33.00	.....	15.39	149.43	39.13	0.77	270.87
Special plant	.....	.....	.....	.....	.....	1.66	.....	.....	.....	1.66
Salaries	1,436	.....	.....	.....	.....	.....	.....	.....	.....	1,436.00
Totals	$1,436	$209.50	$197.31	$253.80	$924.05	$285.53	$1,124.72	$311.93	$259.83	$5,002.81

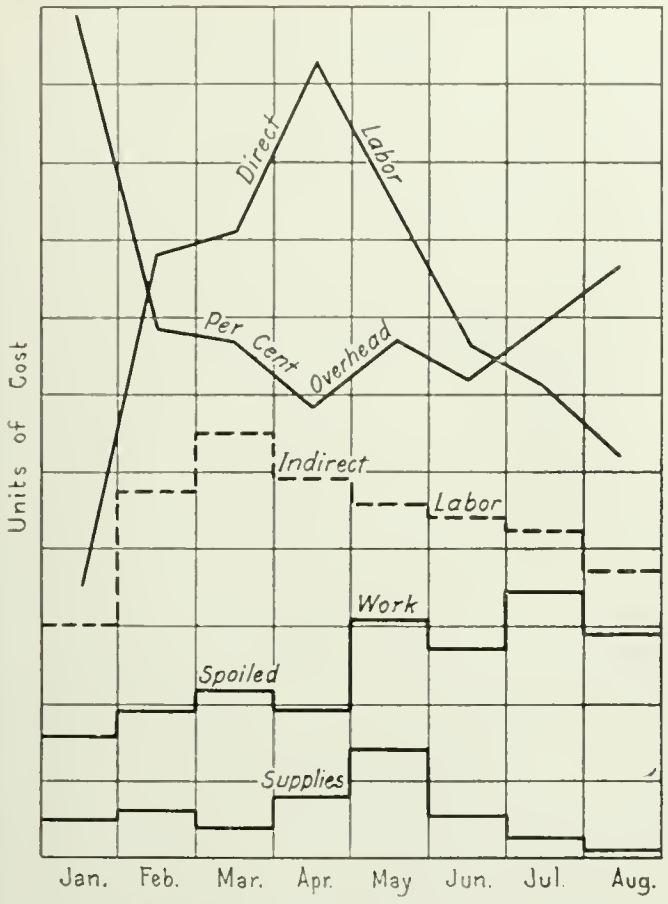

FIG. 10 MONTHLY COST RATIO CHART FOR GUIDANCE OF FOREMEN

partment of a factory. From such a chart the foreman can see the relation between direct labor, scrap, indirect labor, overhead percentages, and other items with which he is concerned.

Table 16 is a tabulated report showing the weekly standings of the productive departments in a factory where piece work is used as a method of wage compensation. This report is calculated from data taken from time tickets and has proved a great incentive to the various foremen to stand at the head of the list, or to attain 100 per cent. It has also resulted in a saving in the cost of the product, for with the entire factory on a 90 per cent piece-work basis the estimated costs as based on time studies are being attained and the small amount of day work is closely watched. It is well known that work done on a day-work basis always costs much more than piece work, and also claims a greater share of the burden expenses due to the inefficiency of slow production.

Before the facts concerning a business are submitted to the foremen an educational campaign may be necessary to get them to think in other than production terms. Production is the aim of every factory, but production at a cost that will enable the product to be sold in a competitive market at a profit. The foremen must appreciate this aim and as soon as they do they are ready to have further data given them as to the detailed operation costs of their departments.

Necessity makes every man a business man on a small scale, for he must divide his income (salary) between food, clothing, shelter, other necessities, and amusements in a way that will meet all demands. If he is a business man after working hours, he can become so during working hours and find a real enjoyment in it. Data which heretofore have been unknown are now made clear, and satisfy the natural desire to know the facts of the business. Very frequently a foreman hears outsiders make statements about his own company which may be complimentary or otherwise. If he knows nothing of the internal conditions of the business he can answer nothing constructive in return. Therefore it is a wise policy which makes it possible for a foreman to get the facts of the business from his own superiors and not from outsiders.

With the items of expense as shown in Table 13 before him, the section head or foreman can analyze the work of his department and make every effort to reduce costs on all controllable items. He will study ways and means to reduce the number engaged in indirect labor, such as clerks, truckers, floor sweepers, errand boys, etc. He will watch the consumption of general supplies such as oil, waste, chemicals, and gasoline, and save all he can. Perishable or small tools will be checked carefully to eliminate waste and careless handling.

The semicontrollable items which are figured on the basis of floor space will forcibly bring to his attention the extent of his department and set him thinking of some way to use less floor space and thereby cut down his expenses. Fixed expenses—interest and depreciation—charged on the value of equipment—can be reduced if the foreman plans to do his work with less machinery in his department. The charges from other departments against the producing departments impress him with the fact that the cost of all indirect departments—plant maintenance, garage, stockkeeping, timekeeping, employment, and others—must all be charged against the product. For, in the final analysis the product that is made and sold must pay all the expenses of the factory. Without concrete examples it is hard to get the foremen to understand overhead, or burden, and how it is arrived at. With the infor-

TABLE 16. PIECE-WORK PERCENTAGE REPORT

Date, July 11, 1923

DEPARTMENT	PRODUCTIVE PIECE WORK HR.	PRODUCTIVE DAY WORK HR.	PER CENT FOR WEEK OF JUNE 9	PER CENT FOR WEEK OF JUNE 16	PER CENT FOR WEEK OF JUNE 23	PER CENT FOR WEEK OF JUNE 30
Mill and drill	2,414	0	100	99	100	100
Automatics	1,963	0	98	100	99	100
Machine drill	1,109	0	99	95	97	100
Plating	276	0	87	100	96	100
Rough grind	1,273	7	100	99	100	99
Filing	384	8	98	100	97	98
Gear cutters	480	14	100	100	99	97
Finished grind	847	28	100	99	98	97
Japanning and lacquering	1,810	122	89	92	95	94
Cabinet	386	27	98	97	92	93
Plant assembly	1,578	131	93	94	92	92
Boring mill	724	59	97	96	87	92
Punch press	1,099	106	86	86	81	91
Tin shop	1,900	202	86	81	83	90
Enameling	800	91	96	94	91	89
Hand-screw	1,626	269	84	86	85	86
Armature	3,948	800	79	85	84	83
Cabinet assembly	498	116	83	85	76	81
Accessory assembly	824	495	74	66	62	62
Special plant	0	194	0	0	0	0
Totals	23,939	2,672	90	90	89	90

mation on the forms, he can soon learn how it is done, and how, by increasing the direct and reducing the indirect labor and expenses, he can reduce the overhead rate for his department.

There is an added advantage of giving, on Table 13, the estimated and actual expenses for the previous budget period and then the estimated amounts for the coming period. Each foreman has the incentive to better the results attained by his department in the coming period over those of the past. It is possible to use the competitive spirit of the men and encourage them, by suitable bonuses or rewards, to improve their departmental efficiency.

Foremen and section heads must realize that the records and reports sent them from their division head are based on the time tickets, material receiving slips, material requisitions, production orders, and other papers filled in by the men under their supervision. It is their responsibility, therefore, to see that data placed on the time tickets, orders, and other papers are correct. This carefulness reacts to give reports which, when checked by the foremen, are found to reflect conditions as they existed, and it also makes possible the calculation of accurate costs which are the basis of logical selling prices.

Figures used in the actual expense items as compiled in the summary of operations by the comptroller are often wrong due to incorrect entries on the original slips. Foremen should realize that they are performing a very important function when they insist that all records that originate or are in any way connected with their departments show actual conditions prevailing at the time. They must not permit men to "juggle" the time consumed on various operations, or else the wages paid will be just to neither employees nor company. Spoiled work must be frankly reported so that the inventory values are kept correct. Foremen often forget their responsibility in the matter of records.

Another advantage of budget analysis by division or section heads, is that it gives them definite figures to check against, and a way to compare the relative efficiency of the departments under their control. With data on estimated allotments and actual expenditures to go by, a close check is secured showing how well each department is measuring up to the standard set for it. A study of these estimated and actual figures will call attention to errors in estimating, and over a period of time will furnish almost exact data on which to base correct estimates even under varying schedules of production.

The following are the advantages to be gained by the use of the budget analysis, which:

1. Forces every executive to think of his work from a business standpoint and to make such plans for the future as will fit in with the program of the management.
2. Enables the division head to understand and be responsible for all expenditures within his division.
3. Enables him to share these responsibilities with the various department heads by breaking information down on a departmental basis.
4. Enables him to check up the operating efficiency of each department through the knowledge which it supplies him of the predetermined operating requirements and the actual expenditures for the budget period.
5. Increases the interest of the entire supervisory organization of a business and unites their efforts in a common endeavor to secure greater profits.

(Concluded in this issue.)

A Method of Increasing Storeroom Capacity

Index Number
658.78 Storage

MOST factories take advantage of the entire vertical height from floor to ceiling when laying out their storerooms. The usual method of getting at supplies in the upper bins and racks is by means of a ladder, often of the variety which travels along a track, or runway.

Where the materials stored at the top are in almost as much demand as those on the lower shelves, and where the ceiling is 14 ft. or more high, a mezzanine floor is a great convenience and time-saver. To reach this floor for the stocking or withdrawal of heavier parts or large quantities of smaller objects, the plant elevator, which is usually adjacent to the storeroom, can be stopped on its trips in either direction. The installation of a safety gate will prevent accidents.

Such an arrangement is shown in Fig. 1. Trucks of small parts from the production departments or from the receiving-room are run on the elevator at the ground floor and wheeled off at the mezzanine platform. Here they are moved to the proper aisle for removing the material. The aisles are broad enough to accommodate the trucks so that unloading can be done directly at the bin where the parts are to be stored. Removal of supplies is, of course, accomplished with the same facility as storing.

FIG. 1 MEZZANINE FLOOR IN A STOREROOM

Organization of Inspection and Maintenance

III—A Co-ordinated System of Planning, Routing, Cost Accounting

By FREDERICK A. WALDRON

Consulting Engineer

Index Number
658.562 Inspection
658.5 Production management

THE two previous articles[1] have outlined the initial stages necessary to design and make a commodity. These stages are absolutely essential whether it be a "one-man shop" or a "thousand-man shop".

If, however, the divisions previously mentioned were the only ones, the time would come when they would be inadequate and would require considerable support. This support is given by the inspection, accounting, and maintenance divisions.

With the engineering and producing divisions in full operation there would develop in the producing division careless and defective work and the lowering of standards prescribed by the engineering division. In order that the producing division's output may be kept up to standard, the inspection division is formed so that an absolutely independent viewpoint may be established as to the character of the work and the standards maintained. The chief of this division ranks with the chief of the other divisions and is directly responsible to the work's manager.

Chief of Inspection Division

The chief of this division must be a man of inherent mechanical ability, keen perception, and firm in his decisions. Yet, he must have those humane characteristics which will enable him to maintain standards of workmanship and materials without creating dissention in the ranks. Above all, he must be fair and just and able to train his assistants to be helpful first, and critical, second.

This division when properly organized and operated will prove a most valuable asset as it will not only be a division of criticisms, but also construction.

Constructive criticism is vital and essential to any industrial organization. It is the inspection division that has this important feature under its jurisdiction and control.

This division should be first supplied with all information required to maintain standards established by the engineering division which should be systematically arranged for daily reference and use.

Gaging and measuring apparatus should be designed and made by the engineering division and turned over to the inspection division. The design of these gages and measuring fixtures should be carefully done with the view of obtaining the maximum speed of inspection consistent with accuracy. The organization of this division is outlined on the chart of Fig. 23 and covers all the salient points required fully to organize an inspection division. Minor or subdivisions can be made on this chart to meet the varying requirements of different lines of product.

The organization and arrangement of the inspection division combined with the detail of its various functions obviously cannot be laid down specifically to cover all conditions. The question of cost of handling under the present conditions of labor make it necessary for each manager to carry out such physical arrangements as will be conducive to the greatest ultimate economy.

This does not mean that the inspection force should be cut down to the last notch, unless it is found that by so doing other elements will not suffer.

The effect of reductions in the inspection force should be carefully studied and planned against the quality of work and the resulting facts on assembling and the scrap pile, as well as the wear and tear on the machinery and the breakage of tools.

There is nothing that tends more to reduce the physical value of a plant than to allow it to run down from lack of proper

[1] See MANAGEMENT AND ADMINISTRATION, January 1924, p. 39; and February 1924, p. 173.

WORKS MANAGER

↓

INSPECTION DIVISION

↓

Machine Operation	Assembling	Final	Materials	Tools and Gages	Fixtures	Machines	Plant
Traveling Inspector *Operation Inspector* *Quality* *Speeds* *Feeds*	*Delivery of Parts* *Action of Groups* *Spoilage*	*Finish* *Operation* *Testing* *Crating*	*Raw* *Finished*	*General Condition* *Recommend Replacement* *Compare with Standards*	*New Fixtures* *Periodical Inspection*	*Periodical Inspection* *Belts*	*General Order* *Fire* *Safety* *Sanitary*

FIG. 23 OUTLINE OF ORGANIZATION OF INSPECTION DIVISION

inspection and repairs. Oftentimes, apparent earnings for two or three years are found to be deficits when the condition of a plant and its ability to continue production are reviewed at the end of this period, due to the fact that the plant has been neglected and the showing made was for the personal aggrandizement of the one in charge.

Need of Plant Inspection

Independent inspection and inspection reports are a means of preventing a condition similar to the above.

Part No.	TOOL AND GAUGE INSPECTION	Operation No.
Name of Part		
Name of Operation		
Tool Number	Drawing Number	

Insp. Dates	REMARKS	Tickler Dates

FIG. 24 TOOL AND GAGE INSPECTION FORM

The extent and scope of the inspection division should not be limited to the product alone, but to a condition of the plant and its daily upkeep.

This section should have an eye to all that has to do with the maintenance of product, standards, machinery, tools, gages, jigs, and fixtures, as well as the general order and neatness. The inspection of fire equipment, motive-power, and fixtures, plumbing, heating, electrical equipment, buildings, elevators, etc., should really be part of the work of the maintenance division, unless the organization is so large that it would pay to have a special branch of the inspection division to cover this work.

Location of Inspection Rooms

The location of inspection would depend on the character of the work, keeping in mind, "Is it cheaper and better to move the material to the inspection room or have the inspector come to the material?"

On products manufactured in large quantities and having a continuous flow from the raw materials to the finished product or worked materials section of the storeroom, it is sometimes advisable to install at certain points enclosures for inspectors so that the work comes in directly from the machines and passes through the inspection room to the next machine operation.

In some places, the inspection room is purposely removed to a remote place in order to remove the possibility of close personal contact of the inspectors with the men who do the work. This arrangement oftentimes is not so extravagant as it seems, for it is quite possible to minimize the cost of trucking and handling to the inspection room by the proper method of planning and routing so that the truckman goes to the inspection room with a full load and also leaves it with a full load. Where materials are manufactured for stock it is best to have this room located adjacent to the worked materials section of the stores.

The above are not intended as specific directions for all conditions, but to outline in a broad way the general conditions and problems which will confront the works manager.

Traveling Inspectors

Traveling inspection is of great assistance to the producing division and is a job of eternal vigilance which if properly performed will more than pay by saving defective work. It should cover such items as the condition of the machines, speeds and feeds, jigs and fixtures, and cutting tools. as well as the occasional gaging of the product during the manufacturing processes, remembering that a "stitch in time saves nine".

There is one element. however, that applies to all industries, and that is the work of the inspector, who, for a better term, is called the traveling inspector. He should be a man of magnetic personality. keen eye, and a good mechanic who has the faculty of mixing, and guiding by suggestion, in a way that will not antagonize the producing division.

A man of this type in a factory does more to prevent spoilage of work than any other individual in the organization, and, moreover, his salary is more than saved through his vigilance. In fact, he becomes a source of constructive criticism and the second pair of eyes for the foreman or "gang boss". The difficulties encountered by this man are many, and it requires time to educate an organization to the point where he is regarded essentially as a helpful factor rather than a critical individual.

MAN'S NO.			
SYMBOLS		NUMBERS	
GROUP		LOT	
SEC		PART	
DIV.		OP'N	
DEPT.		M'C'H	
INSPECTION CARD	DAY P'C'E WORK	NO. P'C'S	
		SP'L'D	
FINISHED		NOT FINISHED	
BAD WORK		REMARKS	
BAD M'T'L			
BAD TOOLS			
GOOD P'C'S			
NO. AND NAME		AMT.	
INSPECTOR O. K.			

FIG. 25 INSPECTION CARD FORM (5 x 3 IN.)

The inspection of tools, gages, jigs, and fixtures is one of the most essential factors of the inspection division. These are foundations for accurate work. It requires a peculiar temperament and skill for this work, and surroundings which are conducive to accuracy. The inspector should be provided with instruments for quickly and accurately measuring the work he is required to check. Not only should new tools be inspected by him before going to the factory, but all existing tools should be periodically gone over in order that their condition may be maintained.

Fig. 24 is provided for use of the inspection and upkeep of tools, gages, jigs, and fixtures. It has been in actual use and has proved very satisfactory.

It shows the basic principles and can be modified in detail to suit the requirements of those in responsible charge of the work. It should be borne in mind, however, that too much detailed information is expensive, and after it passes a certain point it is top-heavy and cumbersome, and very little of it is used. Therefore, in the modification of a form, the following principles should be borne in mind:

1. What is the information in this additional column going to cost?
2. Is it absolutely essential?
3. Will it tend to greater efficiency if it is obtained?
4. Is it really information or curiosity that is to be satisfied?

The chart, Fig. 23, gives in outline the functions of this division. A form of inspection ticket is shown in Fig. 25.

It will be found that if the inspection division is organized along these lines and its work co-ordinated with the producing and engineering divisions that results will be obtained to meet the most sanguine expectations.

Care should be used, however, in the initial organization, not to overdo the organizing of the inspection division but to begin in a small way and gradually educate to a point where it is found the greatest economy results.

It is quite important to influence the mental attitude of the entire organization to look upon this division as a "helpful member of the family" rather than a supercilious critic.

(To be continued in the April issue.)

Identification of Piping Systems by Colors*

FOR a long time pipe lines have been painted in different colors for the purpose of ready identification. Of the various color schemes heretofore devised none has been based upon any definite fundamental principle, either scientific, psychologic, esthetic, or traditional. Because the selection of colors has been arbitrary and influenced by local conditions not common to plants in general, and because a comprehensive extension of such schemes soon involves a mass of detail which automatically renders them difficult if not impracticable, the inadvisability of recommending any of them for adoption as a universal code is obvious.

This condition of affairs was fully recognized by the Sub-Committee on Plan and Scope, which on November 10, 1922, reported as follows:

Identifications. It is obvious that to attempt to outline a code in which every product liable to be transported would have its identification, would result in a system so comprehensive that even should the supply of colors and identification symbols hold out, adoption of it would be automatically rendered impossible in those industries which do not have a major group of colors allocated to its products. It is found, however, upon investigation that any materials transported in pipes in a plant fall in one of the following classifications:

(*a*) Safe Products. This represents a majority of the products that are handled through a plant. Those products may be defined as having no hazard in their handling and no extraordinarily high value, so that a workman in approaching a piping system to make repairs will run no undue hazard in breaking into a pipe bearing a safe material, even though that material had not been emptied by previous arrangement.

(*b*) Extra Valuable Material. This might be classified as a part of the safe materials above mentioned, but inasmuch as cases came to your committee's attention where those products would have a very high value, it appeared preferable to give them a separate major classification.

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Safety

(*c*) Dangerous Materials. These materials are those which inherently in themselves are hazardous to life or property by virtue of being easily flammable or productive of poisonous gases or are in themselves poisonous. They include, of course, materials that are known ordinarily as fire producers and explosives.

(*d*) Protective Materials. Under this class materials which are piped through plants for the express purposes of being available to prevent or minimize the hazard of the dangerous materials above mentioned. Thus, a plant may have certain special gases which are antidotes to poison fumes, which gases are piped through their plants for the express purpose of opening or breaking the pipe in case of danger.

(*e*) Fire Control Equipment. This might properly be called a division of the protective materials just mentioned above, though the hazard of fire and the use of sprinkler systems and other fire fighting equipment having become so universal, it would appear better to make it a special major classification.

These five classifications or subdivisions thereof, if necessary, in the opinion of your committee should be each given a major color, and the various subdivisions that a plant may need can be obtained by the use of numbers, names, or the like, painted in white or black upon a background of the color selected.

The immediate problem of the present sub-committee, therefore, was to select a set of colors for these five major classes in accordance with some basic principle readily understood, easy to remember, capable of expansion, and fulfilling other requirements as to practical availability, ready visibility, resistance to various forms of attack, and indicating in some progressive way the degree of danger or safety.

In any complete color scheme of this sort the natural basis is the solar spectrum, and if we arrange the spectral hues in their natural order in the form of a

* Tentative Report of Sub-Committee on Identification by Colors, presented to the main Sectional Committee on Code for Identification of Piping Systems. Sub-Committee: F. P. Ingalls, chairman, E. J. Cole, I. J. Fairchild, Crosby Field, H. A. Gardner, M. R. Paul. Sectional Committee organized under the rules of the American Engineering Standards Committee with The American Society of Mechanical Engineers and the National Safety Council as sponsors.

circle. this circle may be divided into five sectors, each sector or spectral region representing one of our five major classes and capable of subdivision, where necessary, into a larger number of hues having approximately similar dominant wave lengths, but distinguishable from each other very readily under favorable illumination.

From time immemorial it has been customary to assign a bright red color to all sorts of fire control apparatus. In view of the probability that this traditional habit would endanger the wide acceptance of any code that disregarded it, your sub-committee has selected the red sector and all bright reds as the starting point, and assigns the position of Class 1 to Fire Control.

The position of Class 2 falling in the yellow sector has been assigned to pipes carrying substances that are highly dangerous to health, life, or property if allowed to escape. This selection has been made not only because the yellow quarantine flag warns of something to be avoided but chiefly because the yellow region of the spectrum has the highest visibility and therefore can be seen at the lowest illumination. The assignment of the other three sectors to the remaining classes follows in natural order, i. e.: Safe products, green; protective material, blue; extra valuable material, purple.

With regard to durability there seemed at first to be a general idea that the committee should select five or six indestructible pigments and have paints made from these only. A little reflection soon shows a position of this sort to be untenable, first, because the resistance to attack is limited by the vehicle as well as by the pigment; second, there are few substances either in the inorganic colored pigments or the organic vehicles that are equally immune to all the various forms of attack; and, third, the commercial availability of the materials from which practical and economical paints can be made is by no means a negligible factor.

The system as suggested seems to lose sight of some important facts in economical paint production, facts which have heretofore taken a paramount position in the painting of iron and steel where the protection against corrosion has been of equal or greater importance than the color of the coating.

Black, for instance, has been widely used (not only because it may be made at a low price, but also because it is practically the only paint that will withstand elevated temperatures without discoloration); has a relatively longer life under direct exposure to sunlight, and in the form of asphaltic varnishes is proof against all acids, alkalies, and sulphide sulphur compounds even in relatively strong concentrations. It is the ideal paint for pressure steam pipes but we have taken the position that in most modern plants such pipes are insulated by various kinds of covering mostly white or nearly so and in general not in need of any kind of paint. Such pipes may still be painted black as protection against corrosion and the covering is best marked for identification by the letters, symbols, or signs suggested by the sub-committee having the matter in charge.

The so-called metallic browns and other types of red oxide of iron have also been very largely used in low priced anti-corrosive paints. While the reflective value of the higher qualities of Venetian red is 19 per cent, or better, the darker shades run somewhat lower, and for this reason we believe the dark browns may be excluded from the system with less sacrifice than attends any attempt to retain them.

Aluminum paints also are very useful in many cases and the Committee on Plan and Scope in Part II, Section 7 (b, b) suggests its use for extra valuable materials, which fall in the purple sector.

Gold bronze powders are of no special value and may be omitted without economic loss, but if included for any special reason would fall in the yellow or dangerous sector.

The use of whites and grays has not been emphasized here because in the early conception of the system these achromatic colors were reserved for pipes containing solid materials not subject to flow, specifically conduits carrying wires of any sort.

Your sub-committee therefore presents this system as having sound claims for preference and recommends its adoption for the following special reasons:

1. It is based on definite principles of fundamental character.
2. It is flexible, readily comprehended, and easily remembered.
3. It is practically universal in its capacity, being applicable to almost any conceivable conditions where colored protective coatings of any kind can be used.
4. The differentiation of individuals of the same major group may be accomplished sometimes by variation in the shade of color and at all times by the special markings recommended by the sub-committee specially appointed for that purpose.
5. It leaves the Sub-Commitee on Classification unhampered. Any substance whatever may be assigned to one of the five major groups according to its properties or relationship to the other groups. If it falls naturally at or near the border line between two adjacent groups it may be assigned to either of them without material effect on the system itself.
6. It does not exclude the use of any type of paint or other suitably colored coating. The selection of coating comes under the jurisdiction of the supervising engineer, or person in authority, and is made to meet the diverse requirements of each case. All the system demands is that the dominant hue shall fall unmistakably within one or the other of the five spectral regions, and have a total reflection value of 19 per cent or better.
7. It involves nothing impracticable. If in any plant, the conditions are such that no known colored coatings will give reasonable service, it is obvious that no color system can apply to that plant. The system itself is independent of such considerations.
8. Its arrangement is such that the Permanent Committee on Code for Identification of Piping Systems can make a number of additions and subdivisions if future exigencies demand them, and this can be done without any radical revision.

Methods of Analyzing Financial Reports

Capital Requirements and Control—Article Four

By J. H. BLISS

Controller, Libby, McNeill & Libby

THE purpose of the present article is further to emphasize and illustrate practical methods of analyzing financial statements. Even the more or less limited information generally appearing in published reports may be analyzed and a wealth of information developed.

There cannot be any set or rigid method of presenting analyses of financial statements, because each report will have individual peculiarities, which should be set forth in the analysis. The general procedure and the manner of summarizing should, however, be very clear in mind. Those having occasion to make frequent analyses of financial reports usually find a fairly definite form for setting up the statements and figuring the ratios a great convenience.

Fig. 1 is an illustration of one form which has been found useful and effective in analyzing ordinary financial reports. The figures are filled in for a well-known automobile manufacturer. A careful study of the statement will emphasize the value of the information developed by it, and demonstrate the convenience of the form. Of course, not all published reports supply as complete information as did this one, and the analysis may in some cases be limited. For use internally within a business, all information would be at hand and very complete statistics could readily be developed.

The importance should not be overlooked of drawing together, in a comprehensive and conclusive fashion, the statistics of a business. The difficulty with many statistical compilations is that they fail thus to draw together the few all-important relationships and major points which would be emphasized and presented in condensed and conclusive shape. Detailed statistics are, of course, necessary, but provision should be made for a final summary which will afford the broad viewpoint from which all underlying statistics may be most intelligently used. It will be noted that the form shown in Fig. 1 emphasizes all of the important relationships and sets forth the broad general trends of the business.

This form may be used for making various comparisons, including:

1. Comparisons of annual reports over a period of years, setting forth the trends of the affairs of the business as illustrated by Fig. 1.
2. Comparison of two years, setting out the changes in a separate column, giving particular emphasis to the changes coming about in a fiscal year.
3. Comparison of monthly statistics throughout the year, emphasizing the monthly trend of affairs
4. Comparison of the current month to the same month of the preceding year, which is valuable, as it states definitely the progress made compared to the preceding year.

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658.14 Financial control

Where monthly comparisons are made, it is advisable to state all ratios and turnovers on a yearly basis, in order that they may be readily compared to yearly standards. To present turnovers or ratios of profits earned on investment on a monthly basis in some statistics, and on a yearly basis in other statistics, would be very confusing to the average business man having occasion to use such analysis. The great value in statistics of this character is found in the continuous and thorough supervision of the business which they enable. The possibilities in such data will be more fully appreciated when statistics are developed for some particular company and reviewed in the light of and full knowledge of that company's affairs. These ratios, turnovers, and other relationships point out the tendencies in the business, the "sore-spots" needing attention, and in themselves indicate the character of the corrective action called for.

Reading Changes in Financial Position from the Reports

To describe the changes in the financial position of a business shown by its balance sheets in a readable and easily understandable way is one of the most important duties in interpreting the financial statements of a business. The forms for statements previously illustrated include the detailed balance sheet, the condensed comparative balance sheet, and the analytical balance sheet. As usually prepared, all except the last named are "cold statements" of financial position. While the latter shows considerable analyzed data, it is still a question whether or not the average reader would draw out of it the salient changes in financial position, and fully understand them.

In addition there is needed a condensed statement of the changes which have taken place in a period, presented in an orderly and logical way, so that the average reader may grasp the changes in more or less story fashion. The statement should be, in fact, a story of the financial changes during a period, prepared in such simple and logical style as to set out the salient points clearly to anyone unacquainted with the details of the balance sheet construction and analysis. Such a statement is usually called "a state-

ment of change in financial position," or statement of "application of funds". One might understand from this that there is a well-defined form for preparing such statements. Unfortunately too many accountants try to state these changes in a more or less rigid form of application of funds statement. There should be no set or rigid form for such a statement; there cannot be a set form if the story is to be properly told, for the statement of changes in financial position should be just as individual as the story which it is prepared to tell. Such a statement involves the ability to arrange balance sheets in such a way as to make their story interesting, understandable, and useful to the average business man.

In preparing a statement of change in financial position the important points are usually emphasized as if in answer to the inquiries:

1. What new funds came into the business during the period and from what source?
2. How were such funds disposed of or used in the business?

The answers to these questions may be read from the comparative financial reports of the business for any two years and may be prepared to cover any period of time. It means simply setting out in orderly and logical fashion the changes which one should note from comparative reports.

Illustrations Presented

The remaining sections of this article illustrate the methods of analyzing financial reports and setting up statements of change in financial position. It will be noted that no effort is made to present these analyses in a standard form, for each analysis should be as individual as the changes it records. There are as many different ways of going about this task as there are different stories to tell. The first requirement is to see the story of these changes in the financial statement of the business, and then to write it accordingly.

The illustrations presented are based on the published reports of representative and well-known companies drawn from newspaper clippings and manuals. In each instance the reports are presented in the manner and style in which they were published, save that the figures have been adjusted sufficiently to remove the identity of the particular companies. However, all ratios, turnovers, and relationships are actual.

The analyses given are as follows:

	PARTICULARS	1918		1919		1920		1921		1922	
		Amount	Per Cent	Amount	Per Cent	Amount	Per Cent	Amount	Per Cent	Amount	Per Cent
1	Cash	$2,875	3.8	$4,171	4.8	$4,226	4.2	$8,334	8.4	$15,174	13.2
2	Accounts Receivable	14,468	19.4	8,217	9.3	5,629	5.7	5,827	6.0	4,860	4.2
3	Inventories	17,556	23.5	20,608	23.4	28,077	28.2	22,210	22 6	21,514	18.8
4	Other Current Assets	1,777	2.4	9,199	10.4	2,964	3.0	2,178	2.2	3,510	3.1
5	Total Current Assets	$36,676	49.1	$42,195	47.9	$40,896	41.1	$38,579	39.2	$45,058	39.3
6	Investments	$.....	.....	$.....	.....	$2,267	2.2	$2,258	2.3	$5,578	4.9
7	Fixed Property Investments	17,922	24.0	25,707	29.2	36,163	36.3	37,290	37.9	43.426	37.9
8	Intangible Fixed Assets	19,807	26.5	19,807	22.5	19,807	19.9	19,807	20 2	19,807	17.3
9	Deferred Charges	269	0.4	406	0.4	471	0.5	394	0 4	761	0.6
10	Total Capital Employed	$74,674	100.0	$88,115	100.0	$99,604	100.0	$98,328	100 0	$114,630	100.0
11	Accounts Payable	$2,230	2.9	$3,620	4.1	$2,312	2 3	$3,492	3.5	$6,757	5.9
12	Notes Payable	9,525	12.8	.....	.....	8,500	8.5	.....	.....	.....	.....
13	Other Current Liabilities	2,373	3.2	5,070	5.8	5,525	5.6	6,756	6.9	8,731	7 6
14	Total Current Liabilities	$14,128	18.9	$8,690	9.9	$16,337	16.4	$10,248	10 4	$15,488	13.5
15	Long-term Liabilities	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	Reserves	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17	Capital Stock—Preferred	$10,775	14 4	$10,260	11.6	$9,800	9.8	$9,800	9.9	$9,450	8 2
18	Capital Stock—Common	30,000	40.2	45,000	51.1	60,000	60.2	60,000	61.0	75,000	65.4
19	Surplus Appropriated	4,193	5.6	3,240	3.7	3,645	3.7	4,050	4 2	4,455	4 0
20	Surplus Account	15,578	20.9	20,925	23.7	9,822	9.9	14,230	14 5	10,237	8 9
21	Net Worth	$60,546	81.1	$79,425	90.1	$83,267	83 6	$88,080	89.6	$99,142	86.5
22	Total Liabilities and Capital	$74,674	100.0	$88,115	100.0	$99,604	100.0	$98,328	100.0	$114,630	100.0
23	Net Working Capital	$22,548	....	$33,505	....	$24,559	.....	$28,331	....	$29,570	.....
24	Working Capital Ratio	2.59	....	4.85	.....	2 50	.....	3.76	....	2.91	.....
			Per Cent to Sales		Per Cent to Sales		Per Cent to Sales		Per Cent to Sales		Per Cent to Sales
25	Volume of Business—Units	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
26	Unit per $1 of Plant Investment	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
27	Sales—Amount	$52,088	100.0	$66,383	100.0	$90,652	100.0	$96,691	100 0	$133,179	100.0
28	$ of Sales per $1 of all Capital	0.69	....	0.75	.....	0.91	.....	0.98	.....	1.16	.....
29	$ of Sales per $1 of Plant Investment	2.91	.....	2.58	....	2.51	.....	2.59	....	3.07	....
30	$ of Sales per $1 of Inventory	2.95	.....	3.22	.....	3.22	.....	4.35	.....	6.19	....
31	$ of Sales per $1 of Accts. Rec.	3.60	.....	8.05	.....	16.10	....	16.51	..	27.40	....
32	Gross Earnings	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
33	Per Unit	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
34	Expenses	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
35	Per Unit	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
36	Operating Profits	$4,180	8.0	$9,429	14.20	$9,702	10.70	$12,670	13 10	$20,044	15.05
37	Per Unit	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
38	Per Cent on all Capital	5.59	....	10 70	....	9 74	.....	12 88	...	17 49	....
39	Miscellaneous Loss and Gain	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	Interest Cost	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
41	Per Cent on Borrowed Money	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
42	Surplus Net Profits	$3,884	7 4	$7,243	10.91	$8,949	9.87	$10,410	10 77	$18,086	13 58
43	Per Cent on Net Worth	6.41	....	9.12	.....	10 75	.....	11.82	...	18.24	...
44	Dividends—Preferred	$768	.....	$748	....	$710	.....	$676	...	$674	...
45	Dividends—Common	1,200	.....	2,100	....	3,938	....	4,200	..	6,000	...
46	Dividends-Other (Stock)	.....	.....	.....	.....	15,000	.....	.....	.....	15,000	.....
47	Surplus Adjustments	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
48	Net Change in Surplus	1,917	....	4,394	....	*10,628	....	4,813	..	*3,588	....
49	Total Book Value of Common Stock	$165.90	....	$153.79	....	$122.43	.....	$130.40	..	$119.59	.....
50	Per Cent Earned on Common Stock	10.4	....	14.43	.....	13.73	.....	16.20	....	23 22	...

* Italic figures show Decrease.

FIG. 1 FORM ILLUSTRATING CONVENIENT METHOD OF PRESENTING ANALYSIS OF FINANCIAL STATEMENTS

Figures presented are based on reports of a representative company (000 omitted except where otherwise indicated).

1. Analysis of reports of a manufacturer of heavy machinery and equipment for the years 1914 and 1922. (Fig. 2.) These reports cover a period of 8 years—four war years and four post-war years. The comparison indicates many changes that have come about in the business during that period.
2. A similar analysis of the reports of a specialty manufacturing company, also for the years 1914 and 1922. (Fig. 6.) While the methods of analyzing are very similar the facts developed show an interesting contrast to those of the company given in Fig. 2.
3. Analysis of the reports of an automobile manufacturer for the years 1920, 1921, and 1922. (Fig. 10.) This illustration is of particular interest, as it shows how truly changing conditions in a company are reflected in the analysis of the ratios, turnovers, and relationships to be read out of its financial reports.

	1914	1922
Assets		
Factory Plant	$15,532,000	$31,339,000
Real Estate	436,000	1,155,000
Merchandise Inventory	14,646,000	37,667,000
Work in Progress	421,000	6,383,000
Securities	14,834,000	49,876,000
Cash	11,264,000	24,741,000
Notes and Accounts Receivable	9,546,000	17,577,000
Due From Affiliated Companies	2,530,000	1,364,000
Deferred Charges	.....	683,000
Good-will, Patents, Etc.	.....	.....
Total Assets	$69,209,000	$170,785,000
Liabilities		
Capital Stock	$50,743,000	$94,513,000
Debentures	6,034,000	11,339,000
Accrued Interest	98,000	351,000
Accounts and Notes Payable	828,000	8,140,000
Advance Payment on Contracts	217,000	6,930,000
Dividends Payable	1,015,000	1,809,000
Accrued Taxes	232,000	4,124,000
Reserves	.....	6,989,000
Surplus Account	10,042,000	36,584,000
Total Liabilities	$69,209,000	$170,785,000

PROFIT AND LOSS STATEMENT

	1914	1922
Sales	$15,231,000	$100,097,000
Surplus Net Profits	$ 5,644,000	$13,116,000
Dividends Paid	4,072,000	11,395,000
Surplus Appropriated	.....	200,000
Change in Surplus	$1,572,000	$1,521,000

SALES AND EARNINGS DATA

Year	Sales	Surplus Net Profits	Dividends	Surplus Adjustments	Change in Surplus
1915	$42,761,000	$5,869,000	$1,065,000	.....	$1,804,000
1916	67,121,000	9,295,000	4,061,000	.....	5,234,000
1917	98,463,000	13,452,000	5,583,000	.....	7,869,000
1918	108,407,000	8,552,000	6,876,000	.....	1,676,000
1919	114,990,000	12,539,000	7,159,000	.....	5,380,000
1920	137,879,000	11,066,000	8,047,000	.....	3,019,000
1921	110,504,000	10,827,000	10,077,000	*$709,000	39,000
1922	100,097,000	13,116,000	11,395,000	*200,000	1,521,000
Total	$780,222,000	$84,716,000	$57,265,000	*$909,000	$26,542,000

* Italic figures show Decrease.

FIG. 2 PUBLISHED REPORTS OF A MANUFACTURER OF HEAVY MACHINERY AND EQUIPMENT

	1914	1922	CHANGE
Assets			
Current Assets			
Cash	$11,264,000	$24,741,000	$13,477,000
Notes and Accounts Receivable	9,546,000	17,577,000	8,031,000
Merchandise Inventory	14,646,000	37,667,000	23,021,000
Work in Progress	421,000	6,383,000	5,962,000
Due From Affiliated Companies	2,530,000	1,364,000	*1,166,000
Deferred Charges	.....	683,000	683,000
Total	$38,407,000	$88,415,000	$50,008,000
Securities	$14,834,000	$49,876,000	$35,042,000
Factory Plant	15,532,000	31,339,000	15,807,000
Real Estate	436,000	1,155,000	719,000
Good-will, Patents, Etc.	.....	.....	.....
Total Assets	$69,209,000	$170,785,000	$101,576,000
Liabilities			
Current Liabilities			
Accounts and Notes Payable	$828,000	$8,140,000	$7,312,000
Advance Payments on Contracts	217,000	6,930,000	6,713,000
Accrued Taxes	232,000	4,124,000	3,892,000
Accrued Interest	98,000	357,000	259,000
Dividends Payable	1,015,000	1,809,000	794,000
Total	$2,390,000	$21,360,000	$18,970,000
Debentures Outstanding	$6,034,000	$11,339,000	$5,305,000
Reserves	.....	6,989,000	6,989,000
Capital Stock	50,743,000	94,513,000	43,770,000
Surplus Account	10,042,000	36,584,000	26,542,000
Total Liabilities	$69,209,000	$170,785,000	$101,576,000

INCOME STATEMENT

	1914	1922	CHANGE
Sales	$15,234,000	$100,097,000	$54,863,000
Surplus Net Profits	$5,644,000	$13,116,000	$7,472,000
Per Cent on Sales	12.5	13.5	.....
Per Cent on Net Worth Above	9.3	10.0	.....
Dividends Paid	4,072,000	11,395,000	7,323,000
Surplus Appropriated	.....	200,000	200,000
Change in Surplus	$1,572,000	$1,521,000	*$51,000

* Italic figures show Decrease.

FIG. 3 RESTATEMENT OF REPORTS OF MANUFACTURER OF HEAVY MACHINERY

Published Reports of a Manufacturer of Heavy Machinery and Equipment

In Fig. 2 are presented the reports of a manufacturer of heavy machinery and equipment for the years 1914 and 1922. It is suggested that the reader go over these reports carefully, making as complete an analysis as possible before reading the comments on the following pages.

The outstanding comment which may be made on these balance sheets is that they are not presented in a form designed to enable proper analysis. As the balance sheets are presented there are some accounts about the proper classification of which questions will naturally arise. Deferred charges and the accounts due from affiliated companies might be either current or fixed assets. There is nothing in the report to indicate which would be the fair and proper classification. For present purposes it is assumed that both may properly be treated as current assets.

Published reports, particularly in newspapers or manuals, customarily appear in about this form. Such

reports would be much more effective if the accounts were carefully arranged and properly classified and the change between the two balance sheet dates set forth in a separate column.

In making an analysis of this report the first task is to set up these balance sheets in proper form and compute the changes between the two dates. A restatement of the foregoing reports appears in Fig. 3.

Note how readily the changes in financial position may be read directly from the foregoing report. Note also how much more information may be read out of the reports. On the basis of the last statement it is a simple undertaking to set forth the changes in financial position in simple and logical form. The changes to be noted from these reports might conveniently be summarized along lines shown in Fig. 4.

In addition to analyzing the changes in financial position, all of the various ratios, turnovers, and other matters of interest should be developed. This should be figured from the report in the manner illustrated

FUNDS ADDED TO WORKING CAPITAL:		
1. Surplus Net Profits for 8 years—Period 1914 to 1922	$84,716,000	
Deduct Surplus Adjustment, Net	909,000	
Total		$83,807,000
2. Reserves set aside out of earnings, holding like amount of profits in liquid form		6,989,000
3. Increase in Amount of Debentures Outstanding		5,305,000
4 Increase in Capital Stock Outstanding		43,770,000
Total		$139,871,000
FUNDS WITHDRAWN FROM WORKING CAPITAL:		
1. Dividends Paid in Cash (are 68.3 Per Cent of the Total Surplus Net Profits above)		$57,265,000
2. Increased Investment in Securities		35,042,000
3. Increased Investment in Factory Plant		15,807,000
4. Increased Investment in Real Estate		719,000
Total		$108,833,000
Balance—Increase in Net Working Capital		$31,038,000

CHANGE IN WORKING CAPITAL AND RATIO:

	1914	1922	CHANGE
Total Current Assets (Per balance sheet)	$38,407,000	$88,415,000	$50,008,000
Total Current Liabilities (Per balance sheet)	2,390,000	21,360,000	18,970,000
Net Working Capital	$36,017,000	$67,055,000	$31,038,000
Ratio	16.10	4 14	

FIG. 4 CHANGES IN FINANCIAL POSITION SHOWN BY REPORTS OF MANUFACTURER OF HEAVY MACHINERY

in detail in the second article of the present series.[1] It is necessary here only to present the summary of the changes to be noted. Fig. 5 will serve to illustrate a convenient method of summarizing and explaining the important changes in ratios, turnovers, and relationships.

The published reports for 1914 and 1922 of a well-known specialty manufacturing company (Fig. 6) are used as a basis for this second illustration. From the reports following note that the same general criticism obtains as made of the reports used for the preceding illustration. That is, the reports as published do not lend themselves readily to analysis.

[1] See MANAGEMENT AND ADMINISTRATION for Jan., 1924, p. 25. "The Story Told by the Financial and Operating Statements."

1. The Volume of Sales increased from	$45,234,000 to	$100,097,000
An increase of	$54,863,000 or	121 Per Cent
2. The Surplus Net Profits increased from	$5,644,000 to	$13,116,000
An increase of	$7,472,000 or	132 Per Cent
3. And show a wider margin on Sales, from	12.5 Per Cent to	13.1 Per Cent
4 And a larger return on Net Worth, from	9.5 Per Cent to	10.2 Per Cent
5. But the larger return on Net Worth is due the wider margin earned on sales.		
6. For the total capital employed increased from	$69,209,000 to	$170,785,000
An increase of	$101,576,000 or	147 Per Cent
Which is a larger proportionate increase than shown in sales, and results in—		
7. A slower turnover of total capital used	$0.65 to	$0.59
Sales per dollar of total capital employed due very largely to—		
8. A slower turnover of Inventories, which dropped from	$3.00 to	$2.27
9. But this was partly offset by better turnover of Accounts Receivable	$4 75 to	$5.70
10. And better turnover on Plant Investment	$2.91 to	$3.20

FIG. 5 SUMMARY OF IMPORTANT CHANGES IN RATIOS, TURNOVERS, AND RELATIONSHIPS SHOWN BY REPORTS OF A MANUFACTURER OF HEAVY MACHINERY

	1914	1922
Assets		
Good-will, Trade-Marks, etc	$27,050,000	$27,050,000
Real Estate and Machinery	3,111,000	4,452,000
Manufactured Goods	20,537,000	36,829,000
Stocks and Bonds	10,631,000	14,544,000
Cash	2,996,000	3,994,000
Bills and Accounts Receivable	2,774,000	5,153,000
Due from Other Companies	2,917,000	885,000
Securities	770,000	
Total	$70,786,000	$92,907,000
Liabilities		
Preferred Stock	$26,381,000	$26,350,000
Common Stock	20,121,000	44,794,000
Bonded Debt	2,246,000	838,000
Other Current Liabilities		4,034,000
Preferred Dividends Declared	396,000	395,000
Accrued Interest	74,000	121,000
Taxes and Miscellaneous Accruals	1,682,000	2,783,000
Accounts and Bills Payable	1,828,000	3,463,000
Due Other Companies	73,000	294,000
Surplus	17,985,000	9,835,000
Total	$70,786,000	$92,707,000

PROFIT AND LOSS ACCOUNT

	1914	1922
Sales	$34,669,000	$71,951,000
Surplus Net Profits	$5,817,000	$9,416,000
Dividends	5,605,000	6,956,000
Change in Surplus	212,000	2,460,000

SALES AND EARNINGS STATISTICS

YEAR	SALES	SURPLUS NET PROFITS	DIVIDENDS	SURPLUS ADJUSTMENTS	CHANGE IN SURPLUS
1915	$32,355,000	$5,617,000	$5,605,000		$12,000
1916	35,005,000	6,149,000	5,605,000		544,000
1917	44,960,000	6,655,000	5,605,000		1,050,000
1918	72,235,000	8,306,000	5,605,000		2,701,000
1919	73,011,000	7,986,000	5,605,000		2,381,000
1920	71,553,000	7,575,000	6,279,000	*$18,641,000*	*$17,345,000*
1921	77,981,000	9,127,000	6,955,000	*$2,125,000*	47,000
1922	71,951,000	9,416,000	6,956,000		2,460,000
	$479,051,000	$60,831,000	$48,215,000	$20,766,000	*$8,150,000*

* Italic figures show Decrease.
(Surplus adjusted of 1920 contains stock dividend of $10,065,000.)

FIG. 6 PUBLISHED REPORTS OF A SPECIALTY MANUFACTURING COMPANY

It will be noted that this report also contains accounts, the proper classification of which is doubtful. The item "Securities" is assumed for the purpose of this analysis to represent marketable securities. Ac-

counts due from other companies are assumed to be current assets, though they might be either current or fixed. Accounts due to other companies are likewise assumed to be current liabilities.

As in Fig. 6, to make an analysis of this report, it is first necessary to set up the balance sheets in proper form and show the changes between the two dates. Compare the rearranged and revised statement in Fig. 7 with the published form or report of Fig. 6, and note how much more information may be obtained from it.

From the report, Fig. 7, showing the changes in assets and liabilities between the two dates it is a simple matter to set up a statement summarizing these changes in logical order.

It will be appreciated that if complete final reports are at hand a more thorough and detailed analysis of change in financial position would be possible. The following will serve to show that even ordinary published financial statements may be analyzed in such a manner as to emphasize the more important changes in financial position occurring in a period. (See Fig. 8.)

Further analysis of changes in ratios and turnovers may be made as described in detail in the preceding article.[2] It will serve our purpose to illustrate here, only the summarization of these changes. Some interesting contrasts appear between this analysis and the one preceding. The more important changes in ratios and turnovers which may be read from this financial report are summarized in Fig. 9.

[2] See MANAGEMENT AND ADMINISTRATION, Jan. 1924, p. 25.

	1914	1922	CHANGE
Assets			
Current Assets			
Cash	$2,996,000	$3,994,000	$998,000
Bills and Accounts Receivable	2,774,000	5,153,000	2,379,000
Manufactured Goods	20,537,000	36,829,000	16,292,000
Due From Other Companies	2,917,000	885,000	*2,032,000
Marketable Securities	770,000		*770,000
Total	$29,994,000	$46,861,000	$16,867,000
Stocks and Bonds	10,631,000	14,544,000	3,913,000
Real Estate and Machinery	3,111,000	4,452,000	1,341,000
Good-will, Trade-Marks, Etc	27,050,000	27,050,000	
Total Assets	$70,786,000	$92,907,000	$22,121,000
Liabilities			
Current Liabilities			
Accounts and Bills Payable	$1,828,000	$3,463,000	$1,635,000
Taxes and Misc. Accruals	1,682,000	2,783,000	1,101,000
Accrued Interest	74,000	121,000	47,000
Due Other Companies	73,000	294,000	221,000
Preferred Dividends Declared	396,000	395,000	*1,000
Other Current Liabilities		4,034,000	4,034,000
Total	$4,053,000	$11,090,000	$7,037,000
Bonded Debt	$2,246,000	$838,000	*$1,408,000
Preferred Stock	26,381,000	26,350,000	*31,000
Common Stock	20,121,000	44,794,000	24,673,000
Surplus	17,985,000	9,835,000	*8,150,000
Total Liabilities	$70,786,000	$92,907,000	$22,121,000

INCOME STATEMENT

	1914	1922	CHANGE
Sales	$34,669,000	$71,951,000	$37,282,000
Surplus Net Profits	$5,817,000	$9,416,000	$3,599,000
Per Cent on Sales	16.8	13.1	
Per Cent on Net Worth Above	9.1	11.8	
Dividends	5,605,000	6,956,000	351,000
Change in Surplus	$212,000	$2,460,000	$2,248,000

* Italic figures show Decrease.

FIG. 7 REARRANGED AND REVISED STATEMENT OF A SPECIALTY MANUFACTURING COMPANY

FUNDS DRAWN INTO THE BUSINESS:		
1. Surplus Net Profits for 8-year period 1914 to 1922, inclusive as reported	$60,831,000	
Deduct: Surplus Adjustments other than Stock Dividend	10,701,000	
Balance Net Profits for period		$50,130,000
2. Increased amount of Common Stock	$24,673,000	
Deduct: Stock Dividend Issued	10,065,000	
Balance representing New Capital		14,608,000
Total		$64,738,000
THIS NEW CAPITAL DISPOSED OF AS FOLLOWS:		
1. Dividends Paid in Cash (Are 96 per cent of the Surplus Net Profits)		$18,215,000
2. Increased Investment in Stocks and Bonds		3,913,000
3. Additions to Real Estate and Machinery (Net)		1,341,000
4. Bonded Debt Retired		1,408,000
5. Outstanding Preferred Stock Reduced By		31,000
Total as above		$64,738,000

CHANGE IN WORKING CAPITAL AND RATIO:

	1914	1922	CHANGE
Total Current Assets	$29,994,000	$46,861,000	$16,867,000
Total Current Liabilities	4,053,000	11,090,000	7,037,000
Net Working Capital	$25,941,000	$35,771,000	$9,830,000
Ratio	7.40	4.23	3.17

FIG. 8 CHANGES IN FINANCIAL POSITION SHOWN BY REPORT OF SPECIALTY MANUFACTURING COMPANY

1. The Volume of Business increased from	$34,669,000 to	$71,951,000
An increase of	$37,282,000 or	108 Per Cent
2. The Surplus Net Profits increased from	$5,817,000 to	$9,416,000
An increase of	$3,599,000 or	62 Per Cent
3. Showing more favorable return on the Net Worth, by increase from	9.0 Per Cent to	12.0 Per Cent
4. Realized with a smaller Margin of Profits on Sales, which decreased from	16.08 Per Cent to	13.1 Per Cent
5. And which was possible through larger volume on the Total Capital Used, Which Increased from	$70,786,000 to	$92,907,000
An Increase of	$22,121,000 to	31.0 Per Cent
With Increase in Sales Volume above of		108.0 Per Cent
6. Volume on Investment was larger as shown by better turnover of total Capital Used, Increasing from	$0.49 to	$0.77
of Sales per year per dollar of Capital Used.		
7. This Improvement of Total Turnover is the result of better Turnover of Inventories, from	$1.69 to	$1.95
8. And better Turnover of Accounts Receivable from	$1.25 to	$1.40
9. And better Turnover on Plant Investment, from	$11.15 to	$18.15
10. And was further Improved by large Increase in Volume on the same amount of Good-will and Trade-Mark Investment.		

FIG. 9 IMPORTANT CHANGES IN RATIOS AND TURNOVER SHOWN BY REPORT OF SPECIALTY MANUFACTURING COMPANY

The illustration, Fig. 10, is based on the reports of a well-known automobile manufacturer for the years 1920, 1921, and 1922. The reports are shown in comparative form, in order to emphasize the changes coming about during those years. The year 1920 was a prosperous one. In 1921 that industry felt the full force of the changed business conditions of the readjustment period. In this particular company the recovery in 1922 is noteworthy.

The report as published does not readily lend itself to analysis and it is thought unnecessary to take space to restate it. If an analysis of this report were made

the first step would be to set up comparative balance sheets and income statements in proper form and with analyzed data along the lines indicated by previous forms. The changes in financial position occurring between the close of 1920 and 1922 are summarized in the statement shown in Fig. 11.

It will be noted that the dividends paid out during the two years were more than double the amount of surplus net profits of the period. The net working capital, however, shows an increase due to an increase in the amount of bonds outstanding. From the statement of working capital position the ratio is greatly

	1920	1921	1922
Assets			
Real Estate, Machinery, etc	$7,931,000	$7,722,000	$7,553,000
Investments	3,167,000	3,221,000	3,407,000
Inventories	14,680,000	10,615,000	6,858,000
Cash	2,157,000	2,262,000	2,574,000
Accounts and Bills Receivable	3,117,000	2,217,000	2,316,000
Liberty Bonds	.....	2,900,000	5,108,000
Deferred Charges	352,000	442,000	338,000
Total	$31,404,000	$29,379,000	$28,154,000
Liabilities			
Common Stock	$5,943,000	$5,943,000	$5,943,000
Preferred Stock	7,612,000	7,394,000	7,395,000
Bonded Debt	.....	4,927,000	3,700,000
Accounts Payable	3,720,000	1,903,000	2,239,000
Notes Payable	2,500,000	.....	.....
Reserves	1,250,000	1,250,000	375,000
Surplus	10,379,000	7,962,000	8,502,000
Total	$31,404,000	$29,379,000	$28,154,000

PROFIT AND LOSS

	1920	1921	1922
Sales	$31,299,000	$15,411,000	$18,994,000
Surplus Net Profits	$3,138,000	*$494,000*	$1,058,000
Dividends	1,256,000	673,000	518,000
Reserve for Contingencies	.....	1,250,000	.....
Surplus	$1,882,000	*$2,417,000*	$540,000

* Italic figures show Decrease.

FIG. 10 PUBLISHED REPORT OF AUTOMOBILE MANUFACTURER

improved. This is due in a small measure to the increase in net working capital, but is largely the result of a contraction in both current assets and current liabilities. The reduction in inventories from $14,680,000 to $6,858,000 is particularly noteworthy.

In this business, conditions prevailing in 1921 and 1922, as shown by the reports, are particularly interesting. The volume of business in 1921 was less than one-half that of 1920. While inventories and accounts receivable were reduced very substantially, the reduction was smaller in proportion than the drop in volume of business, and the turnovers show up much poorer by comparison.

The improvement in conditions in 1922 is to be carefully noted. While the sales volume is only 60 per cent of that of 1920, profitable conditions were reestablished. The return on the investment and other ratios and turnovers do not show as favorably as in 1920, yet they show great improvement over 1921. All of these points may be conveniently summarized in a report as shown in Fig. 12.

ADDITIONS TO WORKING CAPITAL:		
1. Surplus Net Profits for the two-year period, 1921 and 1922		$564,000
2. Reduction in Property Investments, either by Depreciation, or Sale, or Write Off, but with Holding Profits in Working Capital		378,000
3. Increase in Amount of Bonds Outstanding		3,700,000
Total		$4,642,000
WITHDRAWALS FROM WORKING CAPITAL:		
1. Dividends Paid Out in Cash		$1,191,000
2. Profits Set Aside for Reserve for contingencies during period	$1,250,000	
Add: Reduction in Balance of Reserves Carried Forward Representing Payments on Contingencies Cared for during period	$75,000	2,125,000
3. Increased Investments (Securities)		240,000
4. Preferred Stock Retired		217,000
Total		$3,773,000
BALANCE, INCREASE IN NET WORKING CAPITAL DURING TWO-YEAR PERIOD AS SHOWN BELOW		$869,000

CHANGE IN WORKING CAPITAL AND RATIO:

	1920	1922	CHANGE
Current Assets:			
Cash	$2,157,000	$2,574,000	$417,000
Accounts Receivable	3,117,000	2,316,000	*$801,000*
Inventories	14,680,000	6,858,000	*$7,822,000*
Liberty Bonds	.....	5,108,000	5,108,000
Deferred Charges	352,000	338,000	.....
Total	$20,306,000	$17,194,000	$3,112,000
Current Liabilities (Deduct):			
Accounts Payable	3,720,000	2,239,000	*$1,481,000*
Notes Payable	2,500,000	.....	.....
Balance, Net Working Capital	$14,086,000	$14,955,000	$869,000
Ratio	3.26	7.67	.....

* Italic figures show Decrease.

FIG. 11 CHANGE IN FINANCIAL POSITION SHOWN BY REPORTS OF AUTOMOBILE MANUFACTURER

	1920	1921	1922
1. Trend of Sales Volume	$31,299,000	$15,411,000	$18,994,000
Comparing with 1920	.....	Off 50 Per Cent	Off 40 Per Cent
But 1922 is better than 1921 by	.....	.....	23 Per Cent
2. The Surplus Net Profits were	$3,138,000	*$494,000*	$1,058,000
3. The per cent on Sales was	10.0 Per Cent	*3.2 Per Cent*	5.6 Per Cent
4. And on Net Worth was	14.2 Per Cent	*2.1 Per Cent*	5.0 Per Cent
5. Total and Average Earnings were	$3,686,000	or 5.5 Per Cent	yearly on Net Worth.
6. But Dividends Paid Out Total	2,447,000		
7. Leaving in the Business	$1,239,000	or 34 Per Cent	of the Earnings.
8. Which was all set aside in Reserves for Contingencies of	1,250,000	.....	.....
	1920	1921	1922
9. The total amount of Capital used	$31,401,000	$29,379,000	$28,154,000
Shows small reduction compared to drop in Sales, and results in—			
10. Slower turnover of Total Capital	$0.99	$0.53	$0.67
11. Inventories were reduced greatly	$14,680,000	$10,615,000	$6,858,000
12 Inventory turnover improved in 1922	$2.13	$1.45	$2.77
13. Accounts receivable were reduced	$3,117,000	$2,217,000	$2,316,000
But not in proportion to sales, making a—			
14 Slower turnover of Accounts Receivable	10 times	7 times	8 2 times
15 No additions made to plants	$7,931,000	$7,722,000	$7,553,000
But drop in volume causes			
16 Poorer turnover on plant investments	$3.95	$2.00	$2.51

* Italic figures show Decrease.

FIG. 12 CHANGES OF CONDITION SHOWN BY REPORT OF AUTOMOBILE MANUFACTURER

Production Control in a Small Organization

II—Profitable Methods for the Small Factory

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Index Number
658.16 Organization

IN adapting staff methods to the management of a small industry, a proper sense of perspective must be maintained as to the magnitude and specific requirements of the plant under consideration, for there is no such thing as a stereotyped set of planning methods. It is important that this be emphasized in a consideration of the small plant, because the factory planning department, as hitherto conceived, has been sketched in terms of the large organization, and has related to plants with personnels of more than 500, the high limit of our small factory range. The picture must therefore be redrawn, as it were, to represent the application of staff characteristics in a miniature and much concentrated way.

Before devising methods for the control of production in a small factory, as in a plant of any size, a preliminary diagnosis of the situation is necessary. The character of the industry, whether continuous process, intermittent process, or a combination of both, must be considered. Local conditions which bear on the storage and routing of material must be investigated, and it may be necessary as an initial step to re-locate or concentrate storerooms, machines, or work benches to secure straight-line-routing with a minimum of retrogression. It may be desirable, at the outset, to weed out a certain amount of idle or obsolete equipment, which serves no purpose or has outlived its usefulness. An efficient trucking system is very necessary. An elevating platform truck used with movable floats will, in some cases, be found most suitable; while a different set of conditions may demand a truck of special design such as is necessary for the safe movement of glass or other fragile material. With proper provision made for these and other features of a general character, attention can be directed to the more specific questions of timekeeping, stores control, scheduling, and cost finding.

To Increase Production and Reduce Costs

It might be well, at this point, to lay stress on the platitude that the ultimate aim of a set of planning methods is to surround manufacture with advantages that will react in such a way as to increase unit productivity and reduce unit cost. No method is worthy of consideration if it does not tend clearly in these directions. Advance estimates of probable savings from a new method must be made with careful judgment, and must be uncolored by any mere prejudice in favor of the method.

The writer has seen many plans prepared, palpably, with "the wish father to the thought," and in which the economies are set forth could be much discounted, and sometimes entirely discounted. These mythical savings recall one of Irvin S. Cobb's "favorite" stories, of a distinguished Japanese visitor who was being shown about New York by a city official. The pair boarded a northbound subway train at Brooklyn Bridge and during the trip to Grand Central changed twice to other trains. On reaching their destination, they sat down for half-an-hour to await the arrival of a police official who was to accompany them during the remainder of the tour. The Jap, who was small of stature, and who had been considerably jostled on the crowded subway platforms, wore a puzzled expression on his face. "Could we not have arrived on the first train, without changing?" he presently asked. "Certainly," was the reply, "but by changing trains we saved four minutes." The Jap pondered again, and then gravely inquired, "And now what are you going to do with the four minutes?"

Need of Simplicity and Concentration

As we approach the actual details of planning, let it again be emphasized that we are dealing with a *small* factory, and that simplicity of detail and a wise concentration of functions, are of first importance. The methods[1] set forth in this article, and the forms reproduced, have, unless otherwise specified, been developed during the past two years, and are now in actual use by the Jacques Kahn Mirror Company in their New York plant. This concern, after a very bad depression year in 1921, during which heavy loss was sustained, realized the need of a better type of management than that which had served during the previous 35 years. They engaged competent industrial counsel, forthwith, and undertook a complete reorganization of the plant, during the process of which, full advantage was taken of all that seemed applicable in what is termed modern scientific management. *The measure of success attained by virtue of the new methods can best be expressed by the simple statement that directly through their use, unit manufacturing cost has been reduced 21.3 per cent—equivalent to a gross annual saving of $25,000, now actually appearing on the general books of the company.* In addition to these directly measurable economies, a system of *management control* has replaced old and inadequate methods

[1] See articles in *Management Engineering* and MANAGEMENT AND ADMINISTRATION, for 1923.

that were, at best, both haphazard and inefficient. And as the plant in question employs a total personnel of just under 100, it can be regarded as a reasonably typical "small factory".

In the opening article[2] on "Organization," a suitable adaptation of planning functions to the needs of a small plant was discussed in some detail. A substantially similar arrangement is reproduced in Fig. 5, an organization chart which shows the planning department of a typical small factory. It will be observed that the production supervisor has reporting to him:

1. *A material clerk or chief storekeeper* who records on stores ledger cards all purchases, issues, and balances of raw material and supplies.
2. *A factory clerk* responsible for the distribution of job-cards to workmen at the beginning of the day, and for their collection at the close of the day. The factory clerk acts also as an order tracer, and must ascertain and record the daily status of orders as they pass through manufacture. He keeps a record of supplies issued to each manufacturing department, and must report these issues daily to the chief storeskeeper, or material clerk, so that the stores-ledger cards covering supplies may be properly balanced.
3. *A schedule and time clerk* who schedules orders in advance through the necessary manufacturing operations, and who, also, on receiving from the factory clerk the day's production or job cards, converts the time spent on each order into dollars of direct labor and manufacturing expense, entering these amounts in their proper columns on the cards. The scheduling clerk also plots and keeps up to date the various Gantt charts used in the control of production.
4. *A cost clerk* who keeps a file of cost sheets, one for each order entering the factory. The cost clerk receives the daily production or job cards from the schedule and time clerk, and transfers the labor and expense amounts for each order to the corresponding cost sheets. He must also receive from the material clerk the value of the raw material issued on each order, entering these amounts also on the cost sheets. At the end of the month the cost clerk summarizes the detailed costs as they appear on the sheets, into totals for each manufacturing order, and enters the proper summaries at the right-hand side of each sheet. The cost clerk also assists the production supervisor in totaling *all* the cost sheet summaries, and in preparing therefrom the monthly Profit and Loss statement, and the monthly Cost Analysis of completed orders. In a general way the cost clerk, in addition to maintaining the detailed cost sheets, assists in the statistical closing of the factory month.
5. *A time study observer and draftsman.* The time-study man records stop-watch observations on manufacturing operations, checks up speeds and feeds of mechanical equipment, compiles standard output figures, computes piece-work and bonus rates, assigns tasks, and develops standard practice instruction cards.

   The drafting function is optional and its inclusion will be governed very largely by the frequency with which changes are made in design of the product or to mechanical equipment. There are, however, few industries within our small factory range that will not, under efficient management, make very profitable use of a draftsman's time. Suitable provision for this function can be made by engaging a time-study observer who can draft, and who will thus be equipped to divide his time between his time-study activities and the drawing board.

The utility and details of these functions will be developed in the progress of this and of subsequent articles. It will be noted that, in a concentrated way, practically all the fundamentals of modern production planning are included.

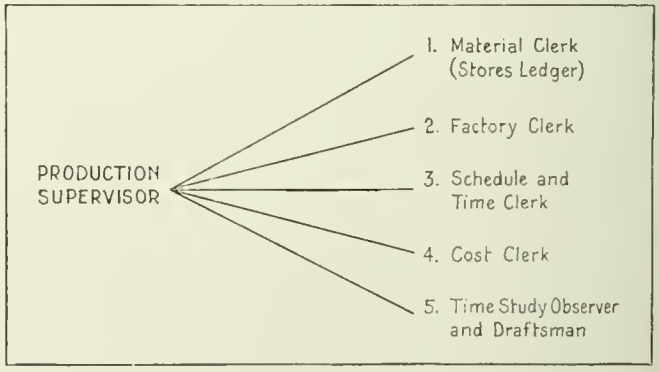

PRODUCTION SUPERVISOR
1. Material Clerk (Stores Ledger)
2. Factory Clerk
3. Schedule and Time Clerk
4. Cost Clerk
5. Time Study Observer and Draftsman

FIG. 5 ORGANIZATION CHART SHOWING ARRANGEMENT OF FUNCTIONS IN A TYPICAL "SMALL FACTORY" PLANNING DEPARTMENT

The production supervisor who directs this miniature planning organization and who we have styled the vice-president's "chief of staff," should possess certain qualifications of a definite character, and likewise a few that are less clearly defined. He should in the first place, have had a technical training similar to that gained in any good engineering school. This is particularly desirable in a small plant, because his function will necessarily demand a thorough comprehension of, and possible direction of, the technical side. In plants of from 50 to 200 personnel, the size of the business will probably preclude the retention of more than one engineering graduate and a production head is indispensable. It is desirable, therefore, that he be equipped to assume a broad rôle, and to attack such technical problems as may from time to time arise. In plants with personnels ranging from 200 to 500, conditions will sometimes warrant the engagement of one or more engineering graduates in addition to the production supervisor, in which case the latter will naturally be relieved of many technical details. The character of this function, however, demands analytical training and ability of a high order. He must be able accurately to diagnose factory conditions; must understand the nature and possibilities of manu-

[2] "Profitable Methods for the Small Shop," MANAGEMENT AND ADMINISTRATION, February 1924, p. 161.

facturing equipment; must be able to prepare and interpret graphical representations; and must be fairly well-read in the latest developments of scientific management. These prerequisites on examination are found to demand the engineering point of view, and a preparation similar to that of the trained engineer.

He should also be endowed with the results of a few years of practical experience, preferably in other factories. Such an experience develops a maturity of judgment that will temper, in a salutary way, the subsequent use of knowledge purely theoretical or technical in character. An early experience as a machine operator or at the work bench is an invaluable asset in that it later gives him a sympathetic understanding of the workman's viewpoint.

In addition to these definable qualifications, he should possess a keen imaginative sense, and the ability quickly to formulate new ideas. Many of his answers must be, perforce, "snatched out of the atmosphere," and he needs to be something of an adept in devising successful ways and means. This demands resourcefulness and a ready imagination.

Summarizing, then, the desirable qualifications for a "chief of staff" in the small factory, we find that he should be possessed of: (a) a quick imagination; (b) an engineering training; (c) a few years of practical experience gained preferably in other factories. And to these three may be added an indispensable fourth, (d) ability to work hard with a minimum of direction, the invariable test of a competent executive.

An efficient time-keeping system, if it is fulfilling its purpose, should record simply, accurately, and in terms of a single working period—usually a day—the following facts in connection with the working force.

1. Who were present and who were absent?
2. Who were punctual and who were late?
3. What each workman did during the working period?
4. How much time was actually spent on each manufacturing order, job or assigned task?
5. The amount of remuneration that each workman earned, expressed not only as a total for the entire working period, but also, as far as practicable, in terms of each of the various jobs that together made up the period.

NAME E Juel DEPT Dy RATE .909 EXP DATE AUG 24 1923

	MACH NO	OPERATION	ORDER NO	SIZE	QUAL	PLATES PER	TIME STARTED	TIME FINISHED	HRS	WAGES	EXPENSE
1		S	4825	Bevel		1	8 0	8 8	80	73	20
2		"	4825	Sol Edges		3	8 8	9 4	60	55	15
3		Rouge	4781	Rouge Wheel		8	9 4	10 9	50	37	11
4		Wht	4825	White Wheel		3	10 9	11 7	80	73	20
5		"	4835	"	"	1	11 7	12 6	40	36	10
6		"		"	"	5	12 6	1 4	80	73	20
7		Rouge	4825	Rouge Wheel		3	1 4	2 3	90	82	00
8		"	4835	"	"	1	2 3	2 7	40	36	03
9		"		"	"	5	2 7	3 4	70	64	05
10		Wht	4858	White Wheel		1	3 4	3 7	30	27	08
11		"	4839	"	"	5	3 7	4 2	50	46	13
			PRODUCTION CARD					TOTAL			

FIG. 6 WORKMAN'S "DAILY PRODUCTION OR JOB CARD"
This card serves simultaneously as a time and attendance record, a production and cost record, and a workman's performance record.

These facts obviously will not be obtained by any crude method such as an attempt to enter workmen's time in a time-book or in a note-book. Their accurate record demands, rather, a well worked-out time-keeping system assisted by some one of the excellent time-recording installations which can be secured commercially. A modern and thoroughly adequate equipment consists usually of a master clock installed at some central point and connected electrically with a sufficient number of time stamps, one or more of the latter being conveniently placed in each manufacturing department. This equipment of master clock and time stamp gains constantly in popularity and can be featured as particularly applicable to the requirements of small plants. The time stamps are, as a rule, simple to operate and of durable construction, while the electrical control renders the entire system automatic, little attention being necessary, other than a periodic renewal of batteries.

The clerical details of timekeeping in small plants can often be minimized by having each workman register his own time, this applying not only to "whistle" time, but also to the time spent on each manufacturing order or assigned task throughout the day. The writer finds this method sound, excepting, of course, instances where a workman, through illiteracy, cannot read his card. In these cases, a foreman, gang-boss, or factory clerk must register for him. Many plants have a rule that no employee is to be engaged who cannot read and write English, a regulation which, if adhered to, effectually eliminates the exceptional condition referred to.

A typical form of time-card, well adapted to the needs of a small plant, is reproduced in Fig. 6. This form known as a "Production Card," serves the double purpose of a daily time record and a daily production or job card. Spaces at the top of the card are provided for the workman's "Name," "Department," "Date," and "Rate". Vertical columns appear under the captions "Machine Number," "Order Number," "Pieces Finished," "Time Started," "Time Finished," "Hours," "Wages," and "Expense".

This production card functions very simply as follows. Each afternoon, the factory clerk counts out a sufficient number of blank cards to provide for all the workmen on the following day, entering at the top of each card the workman's name, department number, and tomorrow's date. Shortly before closing time he gives to each department foreman, or gang boss, his cards for the next day. These cards are then either hung on hooks or placed in convenient racks in readiness for the following morning. As the workmen arrive, each man takes his card from the hooks or from the rack, and carrying it to the time stamp, registers in the "Time Started" column. Thereafter through the day, when he starts or finishes a job he carries his card to the stamp and registers in a similar manner. Any cards that remain after the morning whistle has blown, are removed and taken to the factory office, to which a late workman must come and explain his tardiness before receiving his card, which

has already been rubber-stamped with the word "Late". The cards that still remain represent the absentees, and are so stamped.

The factory clerk also removes from the hooks or rack, all production cards for the day previous, and subtracting time started from time finished, enters the difference in the "Hours" column. Before noon, he brings the cards to the planning office, and gives them to the schedule and time clerk, who quickly extends the labor and expense amounts in readiness for the cost clerk. Cards stamped "late" or "absent" are turned over to the pay-roll clerk, who uses them as a guide in entering the daily pay-roll.

The important advantages to a small factory organization, of a time card similar to that reproduced in Fig. 6, are as follows:

1. It is simple and readily comprehensible to the workmen who use it.
2. It provides simultaneously: a time and attendance record; a production and cost record; and a workmen's performance record.
3. It can be used with equal facility and without the necessity for additional factory forms, to record the time, output, and earnings of workmen employed on the day work, piece work or bonus bases.

Stores Control

The efficiency of management in any plant can be measured to a considerable degree by the exactness and economy with which raw materials and supplies are purchased, stored, issued, and moved to their points of ultimate use. One of H. L. Gantt's frequently quoted statements deals tersely with this phase of management, as follows: "Two-thirds of all the gain possible through the most efficient management can be realized by having all the material ready *when* you want it, *where* you want it, and *in the condition* you want it". To attain these characteristics it is necessary, first, to know the exact quantities of raw materials or supplies that are on hand at any given time. It is necessary then to know how much of each article must be ordered so as to maintain, at all times, a *minimum* balance sufficient to provide for an impending *maximum* requirement. Adequate facilities for storing and transporting material throughout the plant must next be in evidence. It is necessary, finally, that every stage in the foregoing cycle be clearly and accurately recorded.

The volume of turnover in a large factory renders it imperative that a fairly adequate system of stores control be maintained, if manufacture is to be conducted at all. In the small plant with its relatively smaller turnover and closer personal factor, this need seems less obvious, as a result of which many small organizations are found with loose and unsystematic methods of storeskeeping. In many others, stores control, in any worthy sense, is virtually non-existent. It it quite common, in the latter class, to find workmen helping themselves indiscriminately to raw material, supplies, or even valuable tools, without the faintest attempt to record the withdrawal. When the stock runs low, a fresh supply is cheerfully laid in, without any apparent curiosity as to how much of the previous lot was spoiled, wasted, or, as it occasionally happens, stolen.

Passing quickly to a consideration of the elements that should distinguish an efficient "small factory" stores system, it will be found that these are identical with similar features in large plants—modified and concentrated, however, to meet the reduced require-

RECEIVED					ISSUED				ISSUED			
SUPPLIER	DATE	QUAN	VALUE UNIT	VALUE TOTAL	ORD NO	DATE	ISSUED	BAL	ORD NO	DATE	ISSUED	BAL
Gyrdl	1/1/23	200 lb	0.025	5.00	AP	1/3/23	300	535	DP	7/2/23	—	970
"	1/3/23	635	0.025	15.88	AP	1/3/23	—	1170	DP	7/4/23	400	570
"	3/1/23	1025	0.025	25.63	AP	2/9/23	300	870	DP	7/18/23	500	1270
"	4/2/23	1025	0.025	25.63	DM	2/9/23	200	670	DP	7/28/23	—	970
"	7/2/23	650	0.025	16.25	DP	3/1/23	—	1695				
"	7/28/23	650	0.025	16.25	DP	3/10/23	700	995				
					DP	4/28/23	—	2120				
					DP	5/1/23	300	1820				
					DP	5/2/23	500	1320				
					DP	6/4/23	400	920				
					DP	6/8/23	400	520				
					DP	6/6/23	200	320				
Pumice Stone #0								LOC			ORDER POINT	300 lbs.

FIG. 7 STORES INVENTORY CARD

Used as a perpetual record of receipts and issues of both raw material and supplies.

ments of the smaller organizations. These elements are about as follows:

1. A perpetual stores inventory, preferably maintained on visible cards, showing daily receipts, issues, and balances on hand of all raw material and supplies. Inventory cards should express all balances in terms of both *quantity* and *value*, and should show the minimum quantity level or "order point" for each variety of material.
2. A sufficient number of conveniently located storerooms for the proper housing of raw material and supplies, and from which materials are issued *only* upon receipt by the storeskeeper of properly authorized requisitions. These requisitions, or a statement deduced therefrom, should ultimately be forwarded to the planning office, so that the material clerk may balance the stores inventory cards, and the cost clerk make the proper material entries on the monthly cost sheets.
3. A system of recording the quantity and value of material replacements, necessitated either through a previous issue of defective material, or through material spoiled in manufacture.
4. A system of recording the quantities and corresponding values of salvaged material and by-products.

In adapting these features to the small factory, care should be taken to economize, as far as possible, on details. This can best be furthered by making use of the smallest possible number of stationery forms and by securing the maximum degree of utility from each.

Stores Inventory cards, one of which appears in Fig. 7, can be maintained in visible filing cabinets or in

drawers, the same type of card serving for either raw material or supplies. By sending an advance copy of the Manufacturing Order Sheet, Fig. 8, to the factory storeskeeper, the necessity for a special requisition form is removed. As the storeskeeper issues the material, he checks off the corresponding items on his advance order sheet, returning each day's accumulation of these to the planning office, whereupon the stores inventory cards and the monthly cost sheets are properly posted with the material amounts chargeable to each shop order.

A simple requisition blank, made up in pads, can be used to record the issuance of supplies, a rule being *enforced* that no article, however small or inexpensive, be given out other than on one of these requisitions. Each day's accumulation of supply requisitions should be sent to the planning office so that the supply inventory cards can be properly entered and kept up to date.

Defective material, or material spoiled in manufacture, is best reported on a form similar to Fig. 9, known as a "Replace Ticket". One of these forms should be made out by an inspector or by the factory clerk when defective material has been received from the storeroom, or when material has been damaged in process. This form will be recognized by the storeskeeper as authority for replacing the material in question. The replace ticket may then be forwarded by him to the planning office where it will be subjected to analysis, responsibility placed and steps taken to guard, if possible, against a reappearance of the factor that necessitated the replacement. The month's accumulation of replace tickets may also be profitably utilized by the planning office for compiling a statement showing by departments, the monthly expense due to defective material and scrap.

An efficient stores system may thus be attained in the majority of small plants by the proper functioning of four comparatively simple forms.

1. A *Stores Inventory Card* (Fig. 7), one type of card to serve as an inventory record for both raw materials and supplies.
2. A *Manufacturing Order Sheet* (Fig. 8), which is also a bill of material and a raw material requisition.
3. A *Requisition Form* to be used when issuing supplies.
4. A *"Replace" or Salvage Ticket* (Fig. 9), recording the details of necessary replacements due to defective material or materials spoiled during manufacture.

By making each form serve a maximum number of functions, in the manner described, a degree of simplicity and an economy of detail compatible with the

REPLACE 8 27 23 (MO DAY YR)

ORDER NO 4306 CUSTOMER John Wadsworth Co.

QUANT	SIZE	BEV.	SILV.	PATT	QUAL	SALVAGE
1	24 X 58	Plain ✓		1400	I	1-22X16

REASON		AFTER WHAT OPER		LOSS INCURRED	
BREAKAGE Chipped ✓		CUTTING		LABOR	2 25
POOR WORK		ACID		OVERH'D 1	2 10
POOR GLASS		POL. ~~~ ✓		GLASS	3 62
		BEVEL			
BROKEN BY Mathews		P. E.		LOSS	7 97
		MIT			
		SILV			
ORDERED BY J.C		PACKING			

FIG. 9 "REPLACE" OR "SALVAGE" TICKET

Used in reporting the details of necessary material replacements due to defective material or material damaged in process.

miniature requirements of the smallest factory within our range, are readily obtainable.

Harrington Emerson commented, some 15 years ago, on the prevailing absence of output standards and schedules in the industrial plants of that time. He likened the progress of work through a plant, to the progress of old prairie schooners and freight wagons across the plains. "They started when they got ready, they arrived some time, and nobody knew where they were nor what route they were taking in between". This analogy, typical then of industry as a whole, could be applied without much qualification to the majority of small plants today.

In reorganizing a small industry along modern lines, considerable difficulty is often encountered in gaining acceptance for the principle of scheduling orders in advance, through manufacture. This is largely because the operation of this principle seems, at the outset, to interfere more with personal prerogatives, and old habits, than do all the other planning features in combination. It gives the superintendent a pleasant sense of proprietorship, if he feels free at any time during the day to walk up to a workman with a—"Say, Jim, I wish that you would put that order for ..... in work right off. They just telephoned about it. You can finish the job you're working on afterwards." The sales manager feels a glow of importance as he informs an importuning customer, over the phone

CHARGE TO John Wadsworth & Co LOT 5 ORDER NO 6000

SHIP TO Grand Rapids, Mich SOLD BY CUST NO 4001

VIA RECEIVED Oct 1 1923 WANTED Oct 31 1923

SIZE	BEV	SILV	PATTERN	QUAL	PLATES	REMARKS	DATE CUT	SCHEDULING	
18 X 30	—	•	Plain	I	50		3	A-50	A-50
18 X 20	—	✓	"	1	200		4,5 6	A-50 B-50	B-100
22 X 40	—	✓	"	I	150		8 9	B-150	B-150
15 X 28	—	✓	"	III	100		10 11	B-100	C-100
36 X 60	1"	—	342-E	1	10	Sup. memorandum #3562	10	C-10 C-10	

FIG. 8 MANUFACTURING ORDER SHEET

Orders are scheduled in the vertical, right-hand columns appearing under "Scheduling". The symbols A, B, or C indicate the "periods" in a month during which materials will be placed in work—A-50 signifying that 50 plates of glass must be polished during the first period in October. This form serves simultaneously as a raw material requisition, a bill of material, and a manufacturing order.

or by letter, that—"Your order will be shipped on Saturday, if we have to hold up every job in the factory in order to finish it." The order in question is probably a week overdue, the original promise of delivery having been made without any allowance for the volume of work already ahead of the factory. It is precisely these situations and the welter of confusion caused thereby, that scheduling systems are particularly designed to obviate.

No other element of planning, with the possible exception of cost-finding, has as general an effect throughout all departments of an industry as has this one of advance scheduling. Its application involves first, the sales department, because when schedules are observed, no promise of delivery can be made without intelligent reference to, and allowance for, the planned work already ahead. The factory, from stockroom to final inspection, conforms to the requirements of successive schedules, each of these becoming for the time being the guiding spirit of all concerned. And when this orderly dispatching of work replaces methods under which work was not planned at all, the gain is great from every standpoint. Loss of business, through broken promises to customers, is reduced to a minimum. Manufacturing costs are lower through the elimination of expensive interruptions in the orderly progress of work. There is a noticeable improvement in the appearance of factory floors, due to the orderly movement and piling of definite amounts of material in accordance with a preconceived plan. In a general way, the advantages are those that invariably follow the substitution of good order and a definite control, for disorder and an absence of control.

Conditions in the Jacques Kahn plant, prior to its reorganization, were described as follows.[3]

> No attempt had ever been made to schedule orders systematically through manufacture. The sales department, without any knowledge as to conditions in the factory, made definite promises of delivery to customers. The factory, with only a vague knowledge as to the capacity of its various operations, received each day a sheaf of order sheets, with little or no information as to which of these had priority over the others. The word "Rush" written indiscriminately on practically all the order sheets, indicated a desire on the part of the sales office for super-activity in the factory. The result of this lack of co-ordination was manifest, on the one hand, in a constant state of congestion and discomfort in the factory, and, on the other hand, in much annoyance, extra cost and loss of business through broken promises to customers.

In developing the details of a scheduling system calculated to relieve this unsatisfactory state of affairs, the following recommendations were featured. These are reproduced exactly as originally submitted to the Kahn directorate:

1. A month will, in future, be divided into four periods, these to be symbolized as A, B, C, and D.
2. Orders will be promised for completion within one of these periods, not by dates, as at present.
3. The schedule clerk will be supplied with copies or order sheets (Fig. 8). On these sheets, in the proper scheduling column, he will enter the "period" that raw material (glass) will be sent from stockroom to factory, and the "period" or "periods" that it will be placed in work in the various departments.
4. The storeskeeper must send glass to the factory *only* as directed by the schedule clerk.
5. The regular schedule, when established, must be observed, and the regular progress of orders through the factory must not be interfered with.
6. Provision will be made for rush orders, but only when these are reduced to a minimum.

A scheduling system adequate for the needs of a continuous process industry—that is, an industry in which materials pass in a continuous stream through a succession of operations—may be formulated along these lines. The mirror industry is a simple example of this general class. Plates of glass enter the factory and are cut to size and to pattern. They are next polished and perhaps have their edges beveled. They are finally transformed into mirrors by the chemical process known as "silvering". When manufacture is more complicated, as in most metal working plants, where a continuous flow of different parts converge upon a final assembly, additional details will probably be necessary. With proper adaptation, the foregoing features can be regarded as applying to the majority of continuous process industries, large and small alike.

The planning of work through a factory presupposes the existence of standard outputs or capacities that may be reasonably expected from each manufacturing operation. The preparation of such standards usually involves time-study and will be discussed in a subsequent article dealing with that phase of management. It might be mentioned, however, that these standards provide the bases for each successive schedule and are constantly referred to by the schedule clerk.

A scheduling system, to be effective, demands that reliable information as to the daily amounts of work ahead of the various manufacturing operations, and as to the daily outputs from them, be constantly available. There are no better media for the clear presentation of this information, than the straight-line charts devised by H. L. Gantt.

Charts of this type are used extensively in our work, but lack of space prevents their reproduction here. Among the most important are the load chart, which shows the daily volume of work ahead of the manufacturing departments or groups of machines, and the daily and monthly departmental summaries of output and idleness.

Emphasis should be placed on the importance of a *properly located* planning office. The various functions—stores control, scheduling, cost finding and time study—if properly co-ordinated, are complementary and mutually interdependent. They should, therefore, be grouped together in one office, and if possible, be conveniently located with relation to the sales department from which promises of delivery are made to customers. This advantageous arrangement is usually feasible in a small factory.

(To be continued in the April issue.)

[3] See *Management Engineering* for May, 1923, p. 307.

Factory Pay-roll Control in the Shirt Industry

By MICHAEL L. SIEGEL

Factory Pay-roll Auditor, S. Liebovitz & Sons, Inc.

Index Number
658.9:687.211 Shirt factory management
658.3234 Pay-roll control

IN large-scale shirt manufacture the operating divisions are usually scattered about in towns and small cities. One reason for this condition is the desirability of tapping communities which offer a generous supply of women workers, having the double advantage, from the manufacturer's viewpoint, of adaptability to the work required and willingness to operate at a reasonable wage rate.

There are other reasons. For example, some communities are willing to erect buildings in order to induce manufacturers to locate with them. Others offer exceptionally low rentals. The savings effected are, of course, too important to be disregarded by discerning manufacturers. Nevertheless the fact remains that many of these "wayside plants" have operated at a loss, rather than proving profitable ventures.

One of the chief difficulties in the operation of these isolated plants has been the handling of funds for the payment of the operatives. In order to make clear just why this is so, it will be necessary to glance for a moment at the evolution of the very necessary and important article of apparel known as the shirt.

The Problem of Timekeeping

The sack-like affair of the old days, with its shapeless sleeves, was generally made entire by a single operator. But the finished negligee or dress-shirt of today involves 30 different operations in the sewing alone, and each one is performed by a different worker. This advancement, while resulting in finer workmanship, has made the problem of timekeeping far more difficult.

There are further complications of a personal nature in the isolated shirt factory. In organizing such units the usual procedure is for the manufacturer to engage an experienced shirt man or woman to act as plant manager. These people are generally well known in the community, and the operatives working under them are their friends and neighbors.

Thus the plant manager is in the position of having groups of his friends on his pay-roll. Generally he is ignorant of good accounting methods. In the smaller plants, with a maximum of about 25 operatives, no clerical help is engaged. The same is true in many of the larger plants, where local conditions are unfavorable for the securing of competent clerical assistance, and the procuring of help from a larger city is out of the question.

These are some of the problems which have had to be met in the organization with which the writer is connected. The branch factories are widely separated and the pay-roll expenditures run well into six figures. In view of the difficulties indicated above, we have tried to concentrate on the following objectives:

1. To secure a dollar-for-dollar return on labor at each operating point.
2. To operate each factory at minimum expense.
3. To maintain proper morale at all plants, destroying all favoritism and pay-roll padding.

Accounting Method

We have created a department designated as the pay-roll analysis division. This division functions independently of the general accounting department, but furnishes control figures to the company's auditor.

A complete set of forms and books has been devised and installed, a staff of three clerks comprising the personnel of the office. These are a chief clerk, an assistant clerk, and a comptometer operator. The forms in use at the main office are as follows:

1. Pay-roll cards or coupons. (See Fig. 1).
2. Master sheet or working schedule. (See Fig. 2).
3. Recapitulation sheet. (See Fig. 3).
4. Plant ledger or work-in-process record. (See Fig. 4).
5. Voucher receipt. (See Fig. 5).
6. Operators' pay-roll sheets.

The forms in use at the branch factories are:

1. Pay-roll cards or coupons.
2. Master sheets or working schedule.
3. Operators' pay-roll sheets.

The pay-rolls of the organization are subdivided into cutting department, sewing department, and pressing department pay-rolls. The cutting and pressing department operators are hired on a weekly basis. These pay-rolls are made out at the branch factories. The time-in and time-out as shown on the time cards, recorded on standard time clocks, are rechecked. All operators in the sewing department are hired on a piece-work basis, and a careful analysis of their work and payments is made.

Forms and Their Uses

The pay-roll card or coupon is made of Manila card stock with eight spaces, separated by perforations. This card is completely filled out at the branch fac-

tory by the factory manager or his assistant. It contains the following information: name of operation; ticket number; style number; operator number; bundle number; and the price for each operation. These items are all printed except the operator's name, the quantity and the price, which are filled in by the factory manager. These cards show the amount paid against style or ticket, and check the actual performance of the work. They are the posting medium for the master sheets or sewing schedule.

The master sheet is a control against every sewing operation. A copy of this sheet is kept in the factory and also one at the main office for every work ticket issued. This sheet furnishes a safeguard against overpayments, excess amounts being easily discernible. Herein are posted all amounts paid against work in process, and the summary in the corner of the sheet is an exact copy of the data on record in the plant ledgers. The reason for keeping two records is that the master sheet is filed away after the completion of all sewing operations, while the plant or work-in-process ledger is kept intact for one year.

Factory At Keyport N.J

No. 1 Name Mary Smith

Week Ending Sept 1-23 Total 8.60

Operation — **SLEEVING**

ONE OPERATION ONLY ON THIS CARD, EACH OPERATION REQUIRES A SEPARATE CARD

Sleeving	Bundle No.	Doz.	Price	AMOUNT $	c.		
Ticket	1	12	@ 10		120		
No. 8009	2	12			120		○
Make No. 1	3	12			120		
O. P. No. 1	4	12			120	480	

Sleeving	Bundle No.	Doz.	Price	AMOUNT $	c.		
Ticket	11	7	@ 10		70		
No. 8012	13	3 4			33		○
Make No. 5	14	3 4			33		
O. P. No. 1	15	3 4			34	1.70	

Sleeving	Bundle No.	Doz.	Price	AMOUNT $	c.		
Ticket	4	8	@ 10		80		
No. 8011	7	3			30		○
Make No 4	6	5 6			55		
O P. No. 1	3	4 6			45	2 10	

YORK OFFICE

FIG. 1 THIS PAY-ROLL CARD OR COUPON IS THE FIRST POSTING MEDIUM, AND THE SOURCE OF INFORMATION FOR THE MASTER SHEET

The entire card is 13½ in. long, the coupons being 1½ x 1½ in. each.

After the pay-roll cards have been separated as to ticket numbers, a tabulation is made on a recapitulation sheet, showing the ticket numbers and the total amounts paid on each. The aggregate on this statement tallies with the total amount paid out to operators. The amounts are then posted to the plant ledger or work-in-process record.

The plant ledger provides for the following data:

1. Name of factory (Column 1 is used to record the notice from the cutting department that material for the order has been cut).
2. Material.
3. Estimated cost per dozen.
4. Total quantity in lot.
5. Date of shipment out of sewing department to pressing department.
6. Order number and pattern.
7. Date of payments.

8-13. Amounts drawn against order.

14. Price per dozen quoted by contractors.

This record is kept at the main office only, and entries therein are made from the cutting reports, pressing reports, and recapitulation sheets. In some instances this form is a copy of the master sheets, except that there is therein added information showing the transfer of work from one department to another.

The last forms used in connection with this work are the voucher receipt, an acknowledgment of the receipt of salary by the operator, and the operators' pay-roll sheet, showing amounts paid to each worker.

Cutting, Sewing, and Pressing

The cutting department receives from the home office a requisition sheet, generally called a cutting ticket, which conveys to the cutting department an order to cut a designated quantity of shirts. Each cutting ticket is numbered, to facilitate quick reference. After the goods are cut the home office instructs the cutting department to distribute the cut goods to various sewing factories. This function of distribution calls for a complete and accurate knowledge of and familiarity with the capabilities of each sewing factory, as a factory must not be burdened with work unfamiliar to the operators. Some factories, for example, make only flannel shirts; others supply cheap neckband shirts, and still others the finer varieties, including silk shirts, etc.

The sewing factories, upon receipt of their weekly allotment of work, proceed to distribute the various bundles to the operators. Each bundle is properly tagged for identification, with bundle number, plyage, style and ticket number. When the operator completes her bundle of work it is rechecked and her credit is posted on a payeard. These cards are kept by the factory manager, who accumulates them until the termination of the pay period, at which time he sends the pay-cards and pay-roll lists in duplicate to the home office for the check-up and audit.

After the cards have been refigured, analyzed, and corrected, the duplicate pay-roll list (the original having been retained at the home office) and checks are sent to the factory manager as follows: one check covering the entire pay of all operators; and another check for the total salaries of "non-productive help". Checks are generally issued on banks in the towns where the factories are situated, or in nearby towns, in order to facilitate the obtaining of pay-roll cash.

After the sewing of the shirts is completed, they are

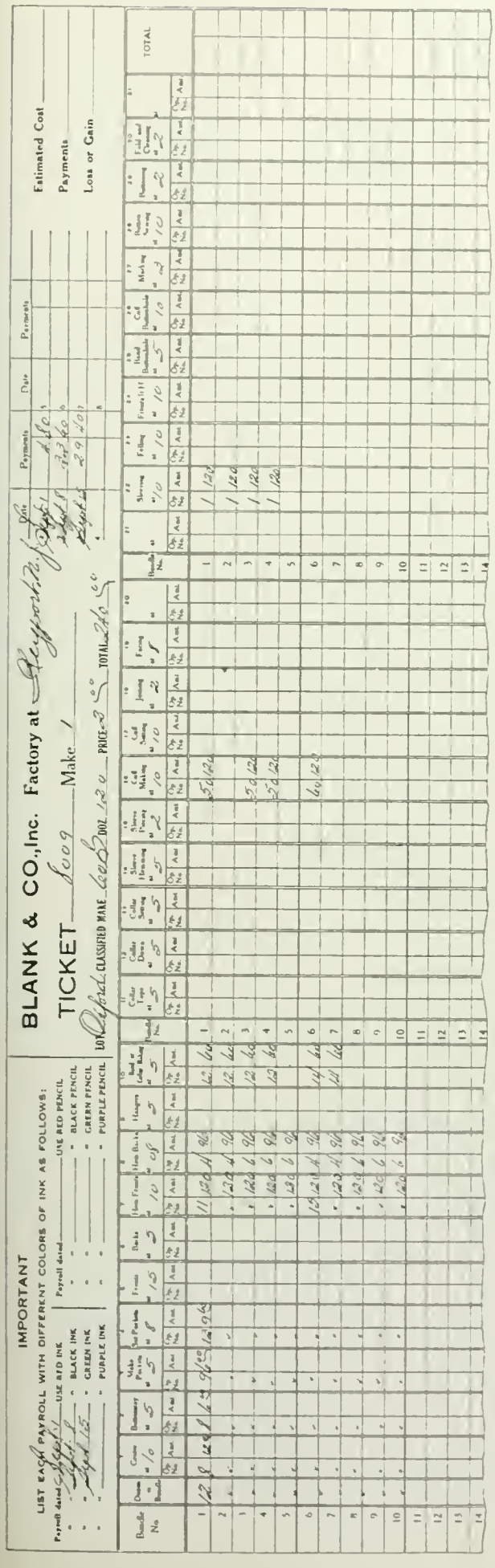


FIG. 2 THIS MASTER SHEET OF SEWING SCHEDULE RECORDS ALL ENTRIES FOR WORK IN PROCESS
To it the pay-roll cards or coupons (see Fig. 1) are posted. The sheets are 22 x 11¼ in. and are filed in a special post binder.

carefully inspected and then shipped to the ironing department. Pay-roll procedure in this department is much the same as that in the sewing department, only that it involves less clerical labor. The pressing of a shirt is done by one person, while the sewing of it requires a large number of different handlings. The shirts are then boxed according to specifications as to quantities in each box—one-half dozen or one-quarter dozen, according to the customers' requirements.

Before the existing system was established, considerable money was lost by the plant managers. Work which was spoiled, as a result of the carelessness of

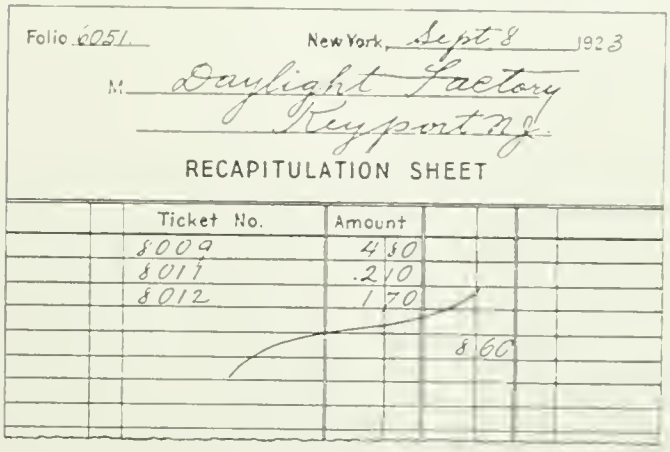


FIG. 3 AFTER THE COUPONS ARE SORTED AND TOTALED, THEY ARE LISTED ON THIS RECAPITULATION SHEET
This is the posting medium for the work-in-process or plant ledger. The recapitulation sheets are 10 x 6½ in. in size.

operators, was paid for at full rates. Higher rates than those authorized were paid to certain favored operators. Carelessness in record-keeping resulted in still other losses.

Favoritism was a particularly difficult problem. Mary Jones, a worker of average efficiency, or better than average, would be receiving $5 a week less than Jane Brown, known to everybody in the plant as a very slow worker. This condition offset to a considerable degree the advantages to be gained in a manufacturing plant from the friendship between the manager and the operators.

The present method of pay-roll accounting helps the factory manager as much as it does the home office. The system is so simple that he can do the work himself or with a practically untrained assistant. Each factory receives a complete supply of pay-roll cards and master sheets, which cover most of the detail work. As a large part of the information on the card is printed, the manager has very little filling in to do. But by following each lot through on the master sheet he has a complete check on all work and payments. As every item is rechecked at the home office, it is seldom that an error gets through unnoticed. If the factory manager puts through a card carrying an overpayment, by failure to make proper deduction or by some other error, the home office checker corrects the mistake and makes the necessary deduction from the operator's pay. All the pay-roll cards are filed and preserved for a considerable time, so that in case a dispute arises concerning any payment, the cards

BLANK & CO., Inc. Bayport, N. J.

Date 1	Lot 2	Price 3	Doz. 4	CREDITS 5	Ticket No. 6	Date 7	Doz.	Price	Amount 8	Amount 9	Amount 10	Amount 11	Amount 12	Amount 13	Cost Elsewhere 14
8/28	Oxford	2.00	120 -	60 11	8009	9/8			4 80						3 -
					605										
8/28	June	2.50	78 11	45 6	8012	9/8			1 70						4 -
					480										
8/28	Plain	4.00	25	10	8011	9/8			2 10						6 75
						Voucher 605			8 60						
					m										

FIG. 4 THE WORK-IN-PROCESS, OR PLANT LEDGER, IS THE CONTROLLING RECORD FOR ALL OF THE SEWING DEPARTMENT OPERATIONS

The sheets are 15¾ x 13¾ in. and are filed in specially constructed binders.

may be looked up and placed in evidence. By this system a very satisfactory money saving is effected.

The office work required of the branch factories consists solely of the proper recording of completed work on pay-roll cards or coupons, the disbursing of the money payments, and the securing of receipts for such payments. All other details are covered at the home office. The procedure at the factory follows:

1. Make out proper pay-roll cards for all work, listing ticket number and proper price, and taking care to write legibly and neatly.
2. Enter this information on the master sheet.
3. List operators' names and earnings. This list is made in duplicate, one copy being forwarded to the home office and one kept in the factory files.

Home Office Procedure

Pay-roll computations and extensions are generally made at the factory, but in some cases, when factory managers are working under special pressure, the extensions are made at the home office, in order to relieve the factory manager of that detail.

The rechecking of extensions at the home office is done by comptometer, in order to assure accuracy and speed. As each operator's amount is checked and found correct it is checked by the operators' list which has been forwarded from the factory. When all the amounts have been proved, a check is drawn for the amount of the total pay-roll and forwarded to the factory manager, who cashes the check at a local bank,

BLANK & CO., INC.

181 VOUCHER No. Sept 8 1923

Name Mary Smith Operator No. 1

RECEIVED of BLANK & CO., Inc.

Eight 60/100 DOLLARS

in full payment for all service for week ending Sept 8. 1923

$ 8 60/100 SIGNED Mary Smith
Write name in full legibly

Checked by M.J.S.

FIG. 5 THE VOUCHER RECEIPT IS A VALUABLE RECORD WHERE THE PAY-ROLL IS DISBURSED IN CASH

In case of a dispute this receipt is taken from the home office file and placed in evidence.

disburses the various amounts, secures receipts, and returns them to the main office. His work is then completed, so far as that particular pay-roll period is concerned.

The next step is the auditing of the pay-roll cards. These are subdivided, grouped, and placed in special envelopes, on the outside of which are noted the name of the factory and the dates of the pay-roll period. The cards, having been thus classified, are ready for the comptometer operator, who secures a total for each batch, representing the amount paid out for a given ticket on each style of garment. These totals are listed on the recapitulation sheet and the information is then ready for posting to the plant ledger.

In auditing pay-roll cards, various ink and pencil colors are used. During the audit any errors, such as paying a higher price than authorized, are uncovered.

Any factory which tries to put over a special price for the work of any favored operator is immediately detected.

Keeping the work down to estimated cost is, of course, one of the main objects of this system. Thus, in posting to the master sheets, it is customary to fill in the price first and then start posting, as it gives a better safeguard on prices. The tendency of factory managers to pay certain operators too much has to be constantly watched.

In posting pay-roll cards or coupons, the card is first compared as to correctness of price; then each card is posted to the corresponding bundle column on the master sheet. Here, for example, is Ticket 8009. There are 120 doz. in this job, the material having been cut in bundles of 12 doz. shirts to a bundle. Operator No. 5, a sleeving operator, has completed 48 doz. sleeves, the assignment covering bundles 1-4. While this work is in process, the account with sleeving bundles 1-4, is closed, and no more money may be paid out for this work. The same method is followed throughout for every operation. When the work is completed, each column is filled in to show that the work has been paid for. Under this method, paying twice for the same operation is impossible. Should a factory report for work already recorded as paid, payment thereon is refused, the master sheet serving as evidence that the work has been paid for.

If time permits, the paycards are analyzed before the check is sent from the home office to the branch factory. But when the check is sent before the analysis is completed, and an overpayment is discovered, a deduction is made from the next wage payment of the operator concerned.

When errors are discovered, the factory manager is notified by a letter from the chief clerk of the pay-roll analysis division, who keeps a special file for such correspondence. Many of the factories have not had to receive such letters, registering a full 100 per cent of efficiency since the new system was set up. When a factory falls down badly on the standard set for it, a member of the home office staff makes a special visit to the plant, offers suggestions, and generally succeeds in straightening out the situation. Also, letters embodying suggestions are sent to all the plants from time to time. The home office staff co-operates in every possible way with the factory managers, and as a result the work generally runs along very smoothly.

The new system has undoubtedly secured for the company a higher grade of work at a considerable money saving. It safeguards the pay-roll and prevents leaks. Under the former plan all that was required was a record of the piece work of each operator, made on one card by the factory manager, who was a sort of factotum—manager, machinist, instructor, and clerk, all in one. He was not by training or disposition a bookkeeper. His writing was generally careless and illegible.

Under the new system, the manager puts a few written figures on a printed form. He is thus released from a large amount of clerical work and can devote his time and energies to his real job, which is to oversee the work of the factory and produce a high standard of operating efficiency.

Finally, the ease with which the system may be operated seems to indicate that it might easily be adapted not only to other branches of needle industry, but to many unallied forms of manufacture as well.

Co-ordinating Purchasing and Production

Index Number
658.78 Materials control

WHEN there is a shortage of the right kind of materials, the production department is the one in an industrial plant which feels it most. The average purchasing department is too far removed from the workshop where intricacies of manufacturing have to be adjusted instantaneously. The ordinary purchasing department looks upon purchasing not so much as a production proposition, but more as a commercial proposition. This difference in viewpoint is natural so long as the separation of purchasing and production continues. We get better results when the routine of purchase planning and expediting are closely co-ordinated with the production planning department. The purchasing agent himself is then set free for the commercial function of actual buying of materials.

Suppose trouble is experienced in processing steel for one part, so that it appears that the part cannot be manufactured to schedule. The materials man learns about the condition at once. He cancels or suspends any additional orders for these parts until the defect is remedied. But that is not all. He knows instantly that the schedules will have to be cut down on other parts which are to be assembled with the deficient one, so as not to make more of them than can be assembled immediately. Therefore, without being told, he begins to choke down the orders for more raw material for these various parts.

When an important machine breaks down, or when anything happens in the shop, the material man knows of it immediately and reacts to the vendor through requests for extra speed, or cancellations, or minor rearrangements in schedule. The stock chasers consider it as much their duty to report to the purchase planner changes in production or in schedule as to report to their own chief. It would be a heinous crime for an individual stock chaser to let a change in production escape the notice of the materials man. This intimate hourly knowledge is valuable in many ways.

The immediacy of control of materials in our particular plant is shown by the fact that when the price slump hit our market after what was called the buyers' strike, we did not have much more material than we could use or than our treasurer wanted to carry financially. Yet our purchases were choked down from one month to the next month nearly 50 per cent, and in the following month were choked down

another 50 per cent. This saved us large losses from having excess stock on hand, or on contract, for which we would be financially responsible. This was especially important in a time when money was tight.

It continued to be important when the market was declining from day to day. It was to our advantage to be able to purchase small amounts exactly suited to a brief period of production. And it continued to be important in the period of jumpy markets and small orders for quick delivery. We are glad that we have our materials under a sensitive and instantaneous control extending back into the vendors' factories.

Knowledge of the sources from which materials are ordered prepares the way for rapid expediting and close adherence to schedules of arrival, but the maximum value of this ability would not be realized if the schedules themselves did not fit production closely. How is the schedule of arrival of materials fitted to production, not only in the mass, but with regard to individual orders? Here the purchase planner works not from the sources, but from the other end, the production department's plans. To judge of the large stream of materials he works from the factory's production schedule for future months, and to meet details, he works from the customer's order.

At the beginning of each month, the planning department gives the stores department a copy of the next month's production schedule. To meet this production schedule, the stores department lays out a schedule of incoming materials, with quantities and dates. This schedule shows which orders should be expedited.

Together with the exact schedule of the month's production, there is laid out a rough estimate of what the production for each of the other following four months will be, and also for the balance of the year. This guides the purchase planner in being strict or lenient in his enforcement of deliveries for bulk material.

Raw Materials Shortage Table

All of these figures are tabulated by the stores department on a "raw materials shortage table". This schedule represents material to be procured ready for manufacture during each month as specified. Materials for each month should be on hand in stores on the first of that month. This gives us time to gather material for all parts of an assembly. A great many kinks are thus removed before it is time to start the manufacture of any of the parts.

The aim of the stores department is usually to keep 30 days in advance of the production schedule; but in times of falling prices and decreasing markets this period can be and is constricted very effectively due to close co-operation between stores planning and production planning on the one hand, and stores and the source factories on the other. Thus the raw materials factories are made tributary to our consuming factory, in delivery schedule and production planning. Our factory can now work with proper co-operation from the raw materials factories. Not only bulk needs, but individual orders, must be prepared for by the purchase planner. If every individual order could go through on time, the bulk would take care of itself. Each of our customer's orders is copied on our own loose-leaf records, and at the same time broken down into sub-orders for the production of each part, one page to a part.

Most plants fall into the habit of purchasing the bulk of their needs of a given material from a certain few sources, for better co-operation, and better prices of larger quantities. Why not print on each production order a few distribution columns bearing the respective names of these firms, and distribute to the proper column the progress report of manufacture of the raw material? The blank for one kind of our materials has four such little columns. The first bears the name of one usual source, the second the name of another, the third is labeled "other sources," and the fourth carries a total of all sources. Four other columns are provided for shipment advices.

Convenience of the System

This system comes in specially handy when we split our order between two or more sources. Manufacturers' progress and shipments from all four are gathered on the same sheet. It is easy to follow total deliveries.

The loose-leaf progress record of the vendor's production and shipments of our raw materials is very simple and easy to keep. On some pages there will be not more than a dozen spaces filled in. Yet each page shows the whole month at a glance. Every Monday morning we add up the receipts on each order during the previous week, and write the total in red to show that it is a total. When we add for a new total at the end of the following week we need only add these red figures to the new week's black figures.

Two figures at the bottom of the page indicate the total production requirement for the month and the pieces which were on hand at the beginning of the month. The difference between these two figures should at least be equaled by the total receipts. If not, we are falling short in our job of supplying materials.

If the receipts are in excess of the pieces required during this month, we compare all the excess with the estimated needs for the following month, which are also shown at the foot of the page. If the excess is reasonable it is a margin to apply on next month's needs. If it is too great, we are loading ourselves up with materials which will cost money for interest on inventory and take up space that we need in our stockroom. So we refrain from placing additional orders for that material, unless conditions are so exceptional that we are anxious to lay in a large stock ahead.

This is the great advantage of tying purchase planning and production planning together. We can instantly readjust our purchase plans to changes in the production needs. The men in the materials department are intimately acquainted with the processes of manufacture and the needs of production, not only in the aggregate, but with individual jobs, parts, and styles to be manufactured.

Reducing the Cost of Shop Trucking

Methods Which Effected Big Savings in the Plants Where Adopted

By ROBERT T. KENT

Mechanical Engineer

Index Number

658.281 Shop transportation

ONLY to a limited extent have manufacturers realized the possibilities of effecting large economies in the conduct of internal transportation in their factories. Nor have they, as a rule, considered the close interrelation of efficient management and the prompt and well-considered movement of work in process from one operation to the next, and from department to department. Shop transportation is such a simple matter, apparently, that it has not been thought worth while in most establishments to waste much time in planning for high efficiency in the movement of material. Even when the plant attains a considerable size, the shop trucking force has been looked on as a necessary evil, incapable of much improvement. Yet when a company employing several thousand men found it possible by an intensive study of the problem, to reduce the force used to move work around the plant from about 90 men to 10, and at the same time to secure better service, it becomes evident that there are possibilities of economy in this department of shop operation that are well worth considering.

While the reduction in direct labor cost due to improvement in the transportation facilities may be no mean item, the indirect savings may, in many cases, overshadow the direct savings and have an effect on production that is far-reaching and almost incalculable.

The Production Problem

Manufacturing consists essentially of subjecting one or more raw materials to a series of processes that change the form and properties, and ultimately assembling these worked materials into the final product. This is true whether the final product be such a simple article as cotton cloth, or such a complicated mechanism as an automobile or a machine tool. The greatest efficiency of plant, and consequently the greatest profit due to operation, results when every process is operative 100 per cent of the time. Delays due to an insufficient supply of material for any process are expensive, not only from the standpoint of idle equipment and labor, but also from the standpoint of lost profits that could have been earned had the material been available. Another aspect, and in some cases a more serious one, is that delays in one operation may stop others further down the line, and the effect is thus cumulative. This applies particularly to continuous processes such as occur in textile work and in some highly specialized phases of machine shop practice.

Such delays as are due to the material not being available when it is needed for a given operation may be obviated in part by so scheduling the work that the material for one job is at the machine before the next one or two preceding jobs are completed. This calls for a high degree of planning. If this is not possible, a large volume of work must be in process at all times so that there is always some work available for each machine. In other words, reservoirs of jobs ahead must be established throughout the plant. In the latter case the amount of money tied up in semifinished goods may run into large figures and have an unfavorable effect on the finances of the company.

If, on the other hand, the transportation facilities are so arranged that the material is laid down at each operation but a short time in advance of its being needed, and is removed to the next process as soon as the work is completed, the time that the work as a whole is in the factory is reduced to a minimum. The investment in goods in process is likewise as low as the character of the work will permit. Also, if a study has been made to ascertain the means of handling the work with a minimum of labor, the cost of transportation will be as low as is possible, consistent with prompt movement, and the saving in operating costs will be an item of considerable proportions.

The Sources of Waste

The greatest waste in shop transportation undoubtedly comes from two causes: An unnecessary waste of labor in handling and rehandling individual pieces in loading and unloading; and the movement of trucks or other carriers incompletely loaded, or their movement loaded in one direction and their return to the starting point unloaded.

A truck, like a machine, is most profitable when it is doing the work for which it was designed for the greatest possible part of the time. The work of a truck is to transport goods to the limit of its capacity. It is not doing this work when it is standing idle, nor when it is standing while being loaded or unloaded. Neither is it doing this work while going empty to pick up a load. Similarly, the man in charge of the truck is not performing useful work when moving it empty, any more than is the man in charge of a machine when the machine is standing idle. The attendant of the truck is performing useful, but unnecessary, work when he loads or unloads it piece by piece.

The fundamentals of economical factory transportation, therefore, are a continuous movement of the carriers, fully loaded in both directions, and a minimum of time consumed in loading and unloading.

Fig. 1 is a conventional outline of a plant employing nearly two thousand men, making a miscellaneous variety of machinery, ranging from very light parts

completed in one or two departments, to equipment weighing several tons, requiring a special erecting shop and crane service. The plant comprises a pattern shop, foundry, machine shops, forge shops, structural steel shop, and the miscellaneous departments that naturally would go with such a works. The machine shops occupy multi-storied buildings, excepting that the heaviest machine tools are located in the one-story erecting shop. The pattern shop and pattern storage is a two-story building, while the remaining shops are one-story buildings with monitor roofs. The number of buildings actually is greater than shown, but the principles involved can be demonstrated in the simpler and more conventional layout.

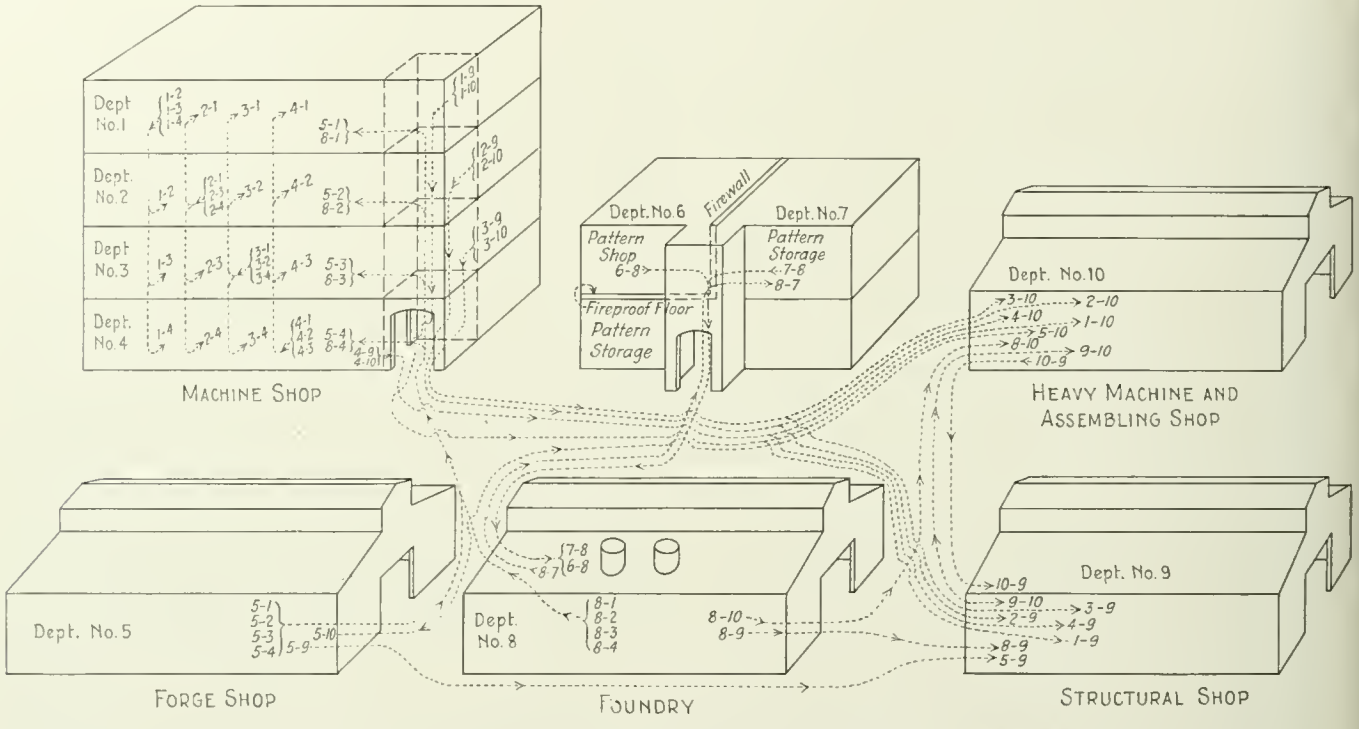


FIG. 1 A PLANT WHERE EACH DEPARTMENT CONTROLLED ITS OWN TRUCKING FORCE; 85 MEN ON 37 ROUTES WERE USED

Before an intensive study was made of the transportation problem of the plant, each department had one or more men whose whole time was occupied with the movement of material from one department to another. These men used small platform trucks, which were loaded piece by piece, and unloaded in the same way at the destination. A man would move a load from his own department to some other, and if there happened to be a load to be returned to his department he might take it with him on the return trip. Usually, however, he returned unloaded, and frequently passed a man who had just taken a load to his department from the one he had just left. As the plant covered a large area, a man might easily be absent from his department for half-an-hour, and most of the time he would be doing no useful work.

Fig. 1 shows the paths of the usual interdepartmental transfers of material. It will be noted that the machine departments sent work to every other machine department, and to most of the other shops. The foundry and forge shops shipped their products to both the heavy and light machine shops, to the assembly shop, and to the structural shop. The structural shop shipped both to the assembly shop and to the customer direct. The foundry also received patterns from the pattern shop and storage, and returned them to storage. Each of these transfers was made by the department's own laborer. The 37 paths of material shown in Fig. 1 by no means represent the total amount of trucking, but they show the principal routes of travel.

It should be stated here that the condition of affairs represented was not the result of a deliberate plan to bring the flow of material under the control of the department last concerned with it. It was rather the result of a gradual extension of a trucking system that started with one or two men when the plant was small, put on to relieve the machine hands of the necessity of moving work. As the plant grew the number of men needed for trucking increased, and finally reached a total of between 80 and 90, without anyone being aware of the extent to which this feature of the business had grown.

When the excessive cost of trucking was suspected as the result of an investigation into another phase of the plant's activity, a study was instituted to reveal the true situation, and to devise means to improve it. It is unnecessary to go into the details of this investigation, but it included a study of the number of loads moved daily from each department to every other department, the average weight of the load, the time occupied by the men in moving the load and returning with the empty truck, the ratio of the return trips made with a load to the return trips made without one, the ratio of trips made with a fully loaded truck to the trips made with partial loads, and the time spent in loading and unloading for each trip.

It was found that the average truckload was some-

what less than half the capacity of the truck; that the trucks themselves were of too low capacity; that trucks moved loaded in both directions only about 10 per cent of their trips; that the men spent about 25 per cent of their time in loading and unloading; that return trips usually consumed from 10 to 25 per cent more time than outward trips, due to the tendency of the men to stop and visit, and also due to the fact that the foremen to whom they reported had little or no check on their movements. In short, the efficiency of interdepartmental trucking was about 15 per cent.

The Remedy Applied

Three things were recognized as essential to effect a radical improvement in the foregoing conditions: (1) Trucks should move loaded in both directions; (2) The time spent in loading and unloading should be reduced to a minimum; (3) The men should be under direct supervision, so that at all times there would be a check on their movements.

To accomplish the first of these requirements it was necessary to change the whole scheme of moving materials. It was not sufficient to instruct a man to inquire when he delivered a load whether there was a load for him to take back. It was necessary so to route him that he would be sure to find a return load. Several means were considered for doing this, including central stations to which all truckers would deliver their loads, and where they would find loads for the return trip. While the central station or clearing house has many advantages that will be discussed later, it was discarded in favor of a fleet of high-capacity electric trucks. These make regular trips over a predetermined route, in the course of which they visit each department, picking up and discharging material as required.

The elimination of the loading and unloading time required careful consideration. At first thought, hand lift-trucks, to pick up loads previously piled on skids were indicated. The electric truck, however, offered so many advantages for the case in hand that this idea was abandoned. Instead of piling the work on platforms or skids, it was placed in tote boxes or other containers of a size to be conveniently handled on the trucks. These were tagged with the number of the department to which they were to be delivered. All work with the exception of large castings and major assemblies, approximating a machine in size, was handled in containers. The problem of loading and unloading was then reduced to the lifting on and off of containers in each department.

Different jobs for the same department were segregated in tote boxes which were distributed within the department by its own men, thus avoiding any delay of the truck. All tote boxes for a given department were placed in a single large container to reduce the loading to a single movement for each department to which shipment was to be made. The total time spent in loading and unloading at each stop was thus reduced to a couple of minutes, and only in rare instances did it exceed 5 min.

Supervision of the trucking force was obtained by organizing it on the basis of a double-track railroad, with a definite schedule of truck movements in both directions. The schedule was so laid out that a truck going in each direction called at every department every half-hour. In addition to the trucks making the regular trips, another truck was maintained for special trips such as the handling of heavy castings or other work which would delay the regular trucks, or would absorb so much of their capacity as to interfere with the steady flow of work through the plant. The truckmen were supervised by a dispatcher who saw that schedules were maintained, and who routed the special service truck in accordance with the needs of the various departments.

Fig. 2 shows that the 37 original routes were reduced to one, with trucks in both directions on it, and covering all parts of the plant. The double-track system was adopted after a consideration of the needs of the plant, and of the character of material to be handled. If trucks had been used in only one direction, heavy castings from the foundry, for instance, destined to the heavy machine shop would have to be hauled through all the light machine departments and the pattern shop before reaching their destination. With trucks in both directions they would be held for the truck going in the opposite direction, and would pass direct to their destination via the structural shop.

When the scheme was in complete operation it was found that a fleet of 8 trucks could easily handle all the work of the plant. This provided for 3 trucks in each direction on the regular routes, one special service truck, and one truck held as a spare. Counting the dispatcher as a part of the regular trucking force, although he had other duties also, 10 men were able to accomplish the work that formerly had required an average of 85.

The Financial Results

From the financial standpoint, the results were even more startling. The men who formerly did the trucking were paid 45 cents per hr. and worked 48 hr. per week. The men on the electric trucks were paid the same wage, and the dispatcher received 70 cents per hr. The old labor cost then was about $1840 per week, and the new one $228, corresponding to yearly totals of about $95,700 and $11,850 respectively. Under the original scheme, however, the truckers helped about their respective departments when not engaged in trucking, and it was necessary to add some laborers to the departmental labor forces to assist in the distribution of the material left by the trucks, and to gather work for shipment. This called for an average of 12 men, at a wage-rate also of 45 cents. The addition to the pay-roll for this purpose and chargeable to the movement of work then was $259.20 per week, or about $13,500 per year. With this addition to the pay-roll, the saving in labor cost over the old method of moving work was about $70,500 per year.

Against this saving there must be charged the cost of operating the electric trucks, consisting of interest on the investment, depreciation, and maintenance charges, and the cost of electric current. These figures may be taken per year as follows: Interest, $1000; depreciation, $3150; maintenance, $1700; electric cur-

rent for charging the truck batteries, $750, making a total cost for operation of $6600, exclusive of labor. The net annual saving due to the use of the electric trucks, coupled with a system of operation that insured their moving under load the greater part of the day, then was $63,900.

This result is almost incredible. Yet the figures are an understatement rather than an exaggeration. Nor is it to be supposed that the case cited is an isolated one. The writer has seen many plants where practically no attention was paid to the problem of handling material other than to add men when the service became slow. The case that has been considered is noteworthy only on account of the size of the plant and on account of the large amount of money involved. The same conditions unquestionably exist in any plant, large or small, that has not analyzed its problem of internal transportation. Even in the smallest of plants it will probably pay to move material by a man especially engaged for this work.

The reason for the cost of handling material growing to a figure out of all proportion to its value is undoubtedly due in most cases to defective accounting. Unless the cost of this item of factory operation is segregated, and clearly reflected in the expense statement, there is no means by which its growth can be controlled. If, however, it is separated from the other items, it can be held at a reasonable proportion of the total expense, and monthly comparisons will check any tendency to undue expansion. A steady growth of this cost, out of proportion to the cost of other operations, will at once reveal the necessity of a survey and the devising of more economical methods.

Mention has been made of the use of clearing stations for interdepartmental trucking. While they were not the best solution for the case under consideration, they nevertheless are ideal for certain classes of plants. Among these are plants operating a number of departments, the product of which may go to any other department, and particularly where the individual shipments are small and of such character that they can best be handled in tote boxes or small containers. Fig. 3 is a diagram of the working of the clearing station system. At the left is a diagram of 8 departments, with the routes followed when each one is responsible for moving its product to each of the others. On the right is a diagram of the same departments routing their product through two clearing stations. The first arrangement calls for 56 routes, on most of which the truck will move unloaded about one-half of the time. The second arrangement calls for but 9 routes, and on these the trucks will usually move loaded in both directions.

Referring to Fig. 3, all material from departments 1, 2, 3, and 4 is delivered to clearing station No. 1, and material from departments 5, 6, 7, and 8 is delivered to station No. 2. The work is classified in the two stations, and loads are made up for the departments served by each. Material for departments served by the other station is classified by departments as far as possible, and then sent to that station, whence it is forwarded to its destination. For instance, a truck bringing a load from department No. 1 will find a load to be returned to that department, being made up of shipments from all over the plant. The truck will thus move under load in both directions. If the work is properly organized, either with lift-trucks or platform trucks loaded in advance by the clearing station crew, there will be no delay for loading or unloading.

The arrangements for handling the work to and from the clearing stations and in the several departments will naturally depend on the local conditions. In one plant, the work of each department was sorted into containers, according to the department to which it

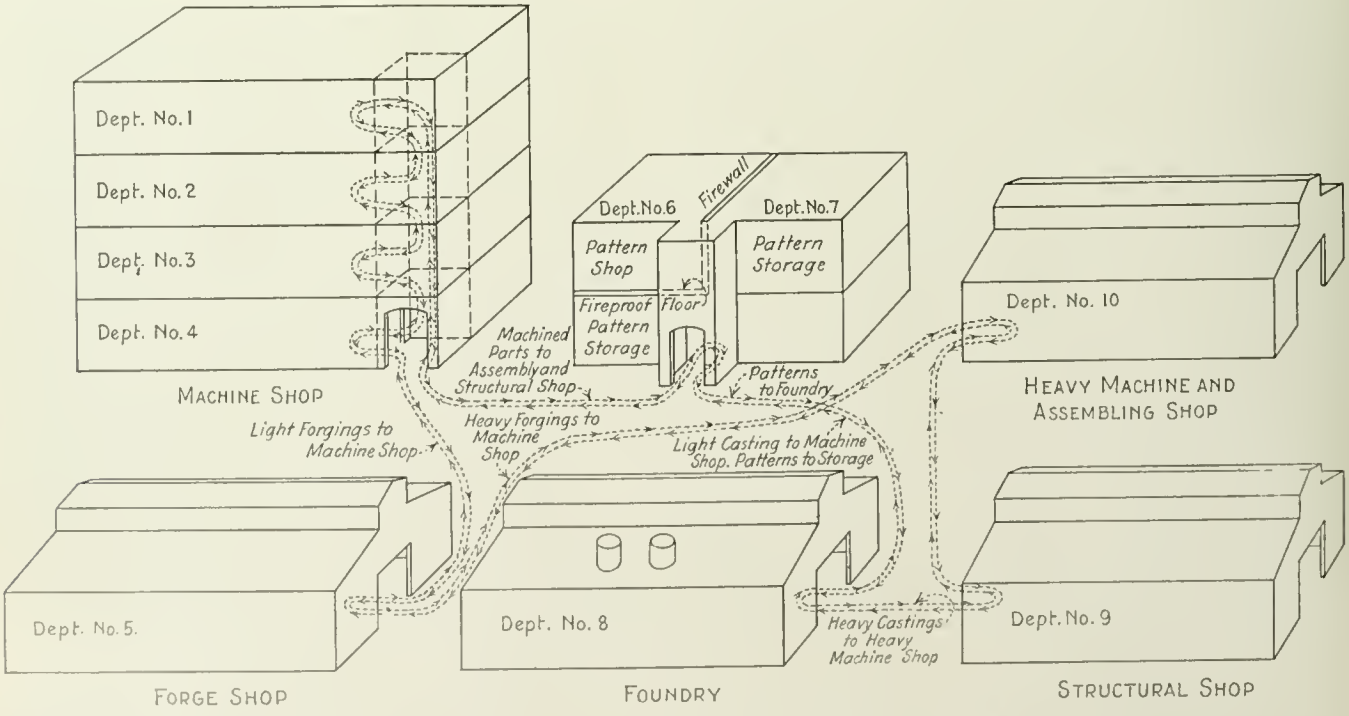


FIG. 2 THE SAME PLANT WITH TRUCKERS CONTROLLED BY A DISPATCHER; 10 MEN AND ONE ROUTE

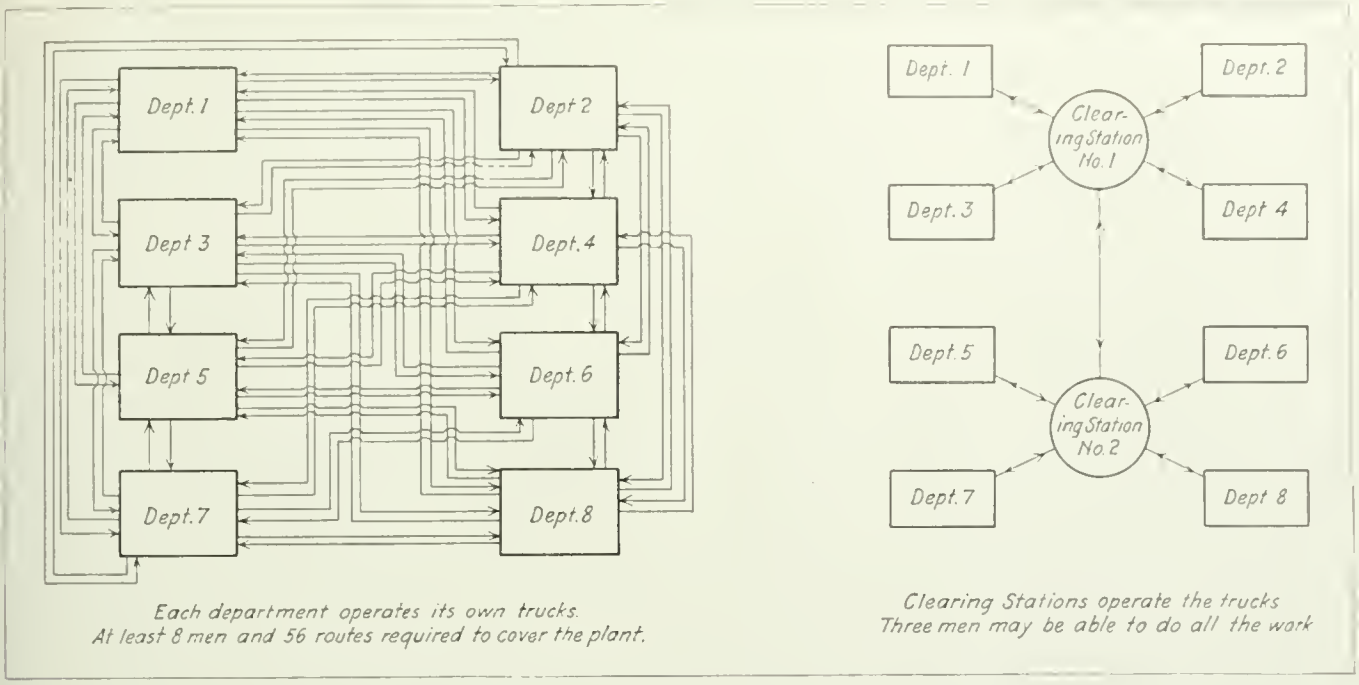


FIG. 3 A COMPARISON OF UNCONTROLLED TRUCKING AND THE CLEARING STATION SYSTEM

was to be shipped, by the inspectors as they inspected it. The containers were placed on skids for a hand lift-truck, which picked them up as filled, and moved them to the clearing stations. Here the containers were sorted to separate skids for each department, including those served by other clearing stations. The loaded skids for departments served by the clearing station were dispatched direct, while those to be sent to other stations were handled by an electric lift-truck. The method of avoiding any unnecessary hand labor in this connection was ingenious, and is shown in Fig. 4.

A platform was built in the clearing station, the top of the platform being the same height as the top of an electric lift-truck skid. An opening was provided in one side of the platform of an area equal to the area of the skid, plus a small clearance. The electric truck thus could place a skid so as to give a practically continuous surface. Runways from the floor permitted hand lift-trucks to be run on the platform and drop their loads on the electric truck skid without rehandling. Usually empty skids were placed along one side of the platform, and the containers from the various departments were sorted to these skids, each destined to a separate department. When the electric truck dropped a loaded skid, the hand-truck skids on it were unloaded to the opposite side of the platform by a hand lift-truck which then moved the loaded skids to the electric truck skid.

The organization of the force of the clearing station is a subject that should be given careful consideration. While it may be desirable to have the truckers, except those engaged in trucking between clearing stations, under the jurisdiction of the several shop departments, as a rule it will be found best to have all truckers report to the clearing stations. The first system may be desirable where the conditions are such that a prompt movement of work out of the department as soon as it is finished is imperative, but the number of men engaged is likely to prove excessive. It is economical only when the volume of work is such as to keep a man fully occupied in moving it, and in this case the electric truck would probably prove a better solution. Where the truckers are under the control of the clearing stations, the number of men can be reduced to a minimum, and it is possible to arrange a definite schedule of trips so that their time can be utilized to the best advantage.

In connection with the use of lift-trucks, either of the hand or automotive type, it should be remembered that they are not confined to the use of skids, nor are they useful only for interdepartmental trucking. The possibilities of this device are only beginning to be appreciated, and it has wide fields of usefulness that have not yet been touched. A careful analytical study

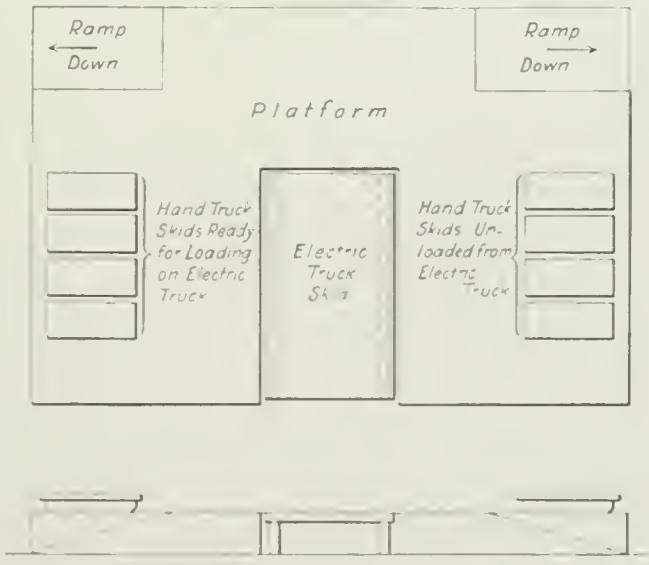


FIG. 4 LOADING PLATFORM IN CLEARING STATION

of the whole subject of moving material will reveal many ways in which it can be used. For instance, lift-trucks have been used to facilitate the assembling of machines.

A certain machine assembled at one spot consisted of several definite assembly groups, the parts for each group being gathered in separate trays about 3 x 4 ft. in size. The trays were then slid into a framework, Fig. 5, so that they formed a set of shelves which could be picked up complete by the lift-truck and moved to the place of assembly. The separation of the elements of the various group assemblies, and the positioning of the trays at the approximate height at which their contents would be used in the machine facilitated the work of assembling. The big saving, however, came from the economy of labor in moving the parts to the assembly floor, and the economy of floor space made possible by the system of shelves. As the loaded trays were too heavy to be moved by hand, this saving was directly due to the adaptation of the lift-truck.

In another case machines were of such a size that they could be conveniently assembled on the bench. After assembly they required inspection and then testing under power. A large saving in time and labor was effected by using the same bench for inspection and testing that was used for assembly. This bench, which was just large enough to accommodate the completed machine, was picked up with the machine on it by a lift-truck, and moved first to the inspector, and then to the testing-room. The bench in question was so arranged that it presented two different heights of working surface to care for different sizes of machines. It was developed by Frank B. Gilbreth and is shown in Fig. 6. The lift-truck will pick up the bench in either position.

Another application of the same bench was its use as a standard for supporting the boxes holding raw material and finished product at the various machines. Time studies had shown that an appreciable amount of time was lost during the day by the mechanics in transferring work from floor to machine and from machine to floor, to say nothing of the fatigue engendered in jobs that required only a few minutes for completion. Bringing the raw material and finished product to the approximate level of the machine, it was shown, would have a most favorable effect on production. Accordingly the rough castings were placed in boxes carried by the benches shown in Fig. 6 and moved to the first operation. The finished work at the first operation was put in a box also carried on a bench, which when filled was moved by a lift-truck to the next operation. The first box, now empty, became the container for the finished work from the next lot of castings. The boxes were made of such size that they completely covered the surface of the bench and contained enough work to last from one-quarter to one-half a day. All piling and rehandling of work, from start to finish of the machining operations, was absolutely eliminated, and the net result of the combination of lift-trucks, special benches, and large containers was to reduce the number of men engaged in moving work by about 75 per cent.

Many other examples might be cited to show the economies that are possible as a result of an intelligent study of moving work. The foregoing, however, are

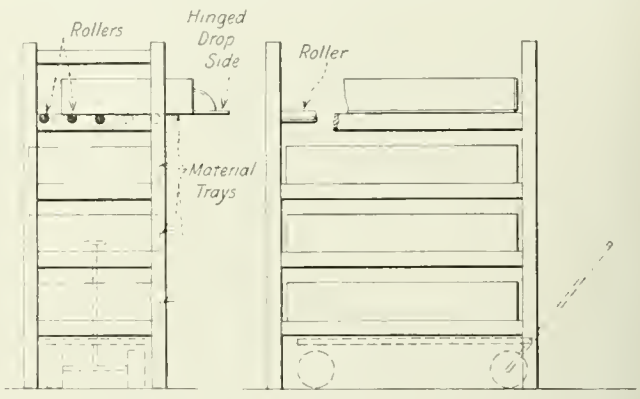


FIG. 5 ASSEMBLY BENCH WITH DIFFERENT HEIGHTS OF WORKING SURFACES USED WITH LIFT TRUCKS

sufficient to give an indication of what may be done. General rules cannot be laid down, since the conditions in every shop are different and require different treatment. For instance, the truck system may be highly satisfactory where the work is of large volume but of varying character, as in the machine tool industry. On the other hand, it would be an absolute failure in such a case as the Ford plant where the tremendous volume of work from each machine is always of the same character. Such a plant, in effect, operates a continuous process, and the movement of material must be studied in the light of the laws which apply to continuous processes.

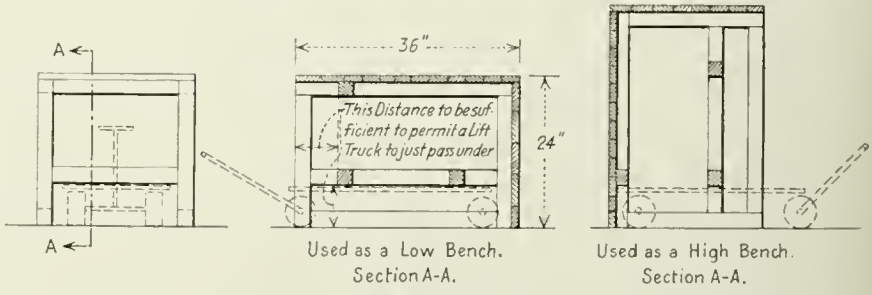


FIG. 6 COMBINED HIGH AND LOW ASSEMBLY BENCH USED WITH LIFT TRUCKS

This at once rules out the truck and substitutes the conveyor. And when we take up the conveyor there are numberless opportunities for mistakes, due to the highly developed state of this field and the great variety of conveyors that are available, some of which are much better adapted to certain conditions than others. The importance of a correct solution of the problem of moving work in the shop, when this runs into a high cost for labor and involves a large volume, is such that it will usually pay to have the study made by an engineer who has specialized in this work. The comparatively small expense of such a procedure will be saved many times in the reduced costs that will result due to the lessening of labor and facilitation of manufacture.

Formulas for Shipping Box Construction

Forces Acting and Sizes of Material Required to Withstand Them

By MILTON L. CGLESBY

Engineer, Freight Container Bureau, American Railway Association

Index Number
658.78844 Shipping cases

IT has occurred to the writer many times, that in the literature on containers and packing, the mathematical treatment of the mechanics of containers, considered as structures, has been neglected.

No engineer attempts the design of a structure without the use of mathematics to some extent, depending upon the importance of the work he has in hand. He may use comparatively simple formulas, but even these simple formulas are the result in many cases of long and careful analysis. He does not have to go into the analysis in each case, as he can usually depend upon the authority by whom the formulas were evolved.

Containers, boxes, barrels, etc., have not usually been considered as structures, because they have always been with us, and, like Topsy, have apparently "just growed". The engineering mind, however, takes a different point of view of the question, and it remains only to establish the importance of the subject in order to justify attacking the problem from this point of view.

At least one-sixth of all of the lumber cut in the United States is converted into containers of some sort—boxes, barrels, or crates—and this now amounts to close on 5,000,000,000 ft., bd. measure, of lumber per annum, a very tidy amount. An estimate of the number of these containers made in 1922 apparently shows that in that year about 11,000,000 cars were loaded with L. C. L. shipments and that these carried not less than 2,000,000,000 containers. There were, of course, many additional containers in C. L. shipments. In October 1914 to April 1915, out of a count of 5,000,000 boxes about 24 per cent were of paper including both solid fiber and corrugated strawboard; while a second count in the spring of 1923 showed that out of 48,000 boxes 9.6 per cent were of solid fiber and 21.2 per cent were of corrugated strawboard, the basic material of both these being wood also. The importance of careful design in order to effect the greatest economy of material and at the same time conserve the strength of these containers in all of their details seems to be fairly established.

It will be argued that a mathematical discussion is all "theory" and of no practical value; that "common sense" applied to the same problems will produce better results. This arises from a popular misconception of just what "theory" is. To my mind, theory is the explanation of established facts and this requires the utmost common sense to develop. If we have insufficient facts we might develop a poor theory or even a wrong theory entirely—we have then merely an "assumption" and no theory whatever although it appears masked as such. Common sense, therefore, is clearly necessary to differentiate between these two. A theory, properly developed, has as a basis all of the facts with which it is related condensed to a workable form. It may be relied upon as a law of nature and only by adherence to it can we effect the greatest possible economies or avoid errors.

In treating the subject I have attempted to set forth the laws governing containers under three general headings. The first of these will be the development of general formulas for containers as structures, these will be similar to the formulas for all structures; second, the application of these formulas to the details of construction we are forced to use for containers; third, the effect of interior packing of the commodity in reducing the stresses upon the members of the containers. Only the first of these three subjects appears in the present article. In considering the forces which cause the failure of a box by the breaking down of any of the parts, the most important to be considered are those due to the weight of the box itself and its contents, since usually these only are determinable in kind and intensity. All other forces which might act upon the box, and in which the weight of the box and contents are in no way involved, are usually indeterminable in direction and disposition and may be unlimited in intensity.

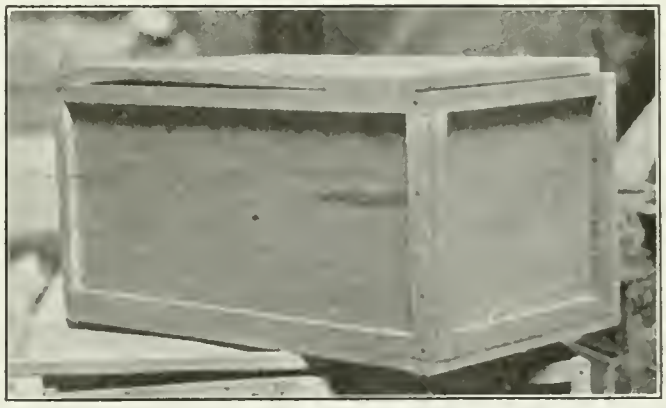


FIG. 1 FULL PANEL BOX OF 3-PLY WOOD VENEER EACH FACE REINFORCED BY FOUR CLEATS

Interior and Exterior Forces

For the purpose of this treatment I have designated the former of the above forces (those in which the weight of the box and contents are involved) as interior forces. These forces and their effects upon the various elements of box construction will be investigated first.

Those forces in which the weight of the box and contents are not involved I have designated as exterior forces and only a few special cases may be investigated.

Since, fundamentally, the force which any body in motion exerts may be measured by the product of its mass and its acceleration, and, further, since the mass of a body is proportional to its weight, we may always represent the interior force acting upon a part of the box as a function of the weight of the box and contents, as:

$$F = \text{some function of } (W_b + W_c) \quad \text{[A]}$$

where F is the force to be considered, and W_b and W are the weights of the box and its contents, respectively.

Furthermore, since the weights of boxes of the same type, relative proportions, and containing the same commodity will always bear approximately the same proportion to the weights of this commodity, we may neglect the refinement of considering the weights of box and commodity separately and write equation [A] as

$$F = KW \quad \text{[B]}$$

where K is a factor depending upon the conditions at the instant the force F is to be considered and W is the gross weight of the package.

Any force may be considered as falling into one of two classes—a static force which is applied gradually by small increments such as a dead load; or a dynamic force which is applied suddenly, as an impact, or blow, or live load. These latter produce resultant deformations in excess of static loads of the same value, but may be investigated in the same way if due regard is paid to the manner of their application.

A body in motion, with a velocity V has a kinetic energy equal to the product of the mass of the body into the square of the velocity. Expressed in terms of its weight this is equal to $\frac{WV^2}{2g}$, where g is the acceleration due to gravity. The body in this state is capable of performing work to the amount of its kinetic energy, and, if all of the energy be absorbed within the body in bringing it to rest, forces will be set up, with corresponding deformations, and the sum of the products of all of these forces and the deformations will be equal to the kinetic energy which the body had at the start.

There is a limit, however, to the forces which materials can bear, in other words their ultimate strength. Somewhere below this there is another limit, known as the elastic limit, at which the deformation produced by a force ceases to be proportional to that force. The elastic limit under static stress does not correspond to the elastic limit under dynamic stress, and for timber the latter has been found to be approximately twice the former.[1]

If a body of any material be loaded up to its elastic limit and the load or force then removed, the body will return to its original shape. If the body be loaded beyond the elastic limit but not to the point of ultimate strength it will acquire a permanent deformation or "set," in addition to the elastic deformation, which will remain as its name indicates after the load or force is removed. If the body be loaded beyond the point of ultimate strength rupture occurs and the utility of the body is destroyed so far as its original purpose is concerned.

For reasons of safety and utility most structures are designed so that possible loads coming upon them cannot stress them beyond their elastic limit.

Sufficient data have not been accumulated for many materials as to the ultimate strength under impact when ruptured by different methods such as tension, shear, etc. We cannot depend in these cases upon formulas in which the forces acting exceed the elastic limit. Up to that point we can depend, however, on the data accumulated, and in the following treatment involving the strength of a material it is to be understood that the maximum unit stresses involved in no case exceed the elastic limits, in other words, $F = KW$ must not produce stresses within any element of the container beyond the elastic limit for the material of the element and corresponding to the nature of the stresses investigated.

FIG. 2 FAILURE OF A PANEL BOX OF 3-PLY WOOD VENEER DUE TO NAIL HEADS PULLING THROUGH PLYWOOD

Principally a shear failure accompanied by some splitting. Remedy: The use of nails with larger heads.

Denoting the kinetic energy of a moving container, such as a box, by U, this may be represented by

$$U = \frac{WV^2}{2g} \quad \text{[1]}$$

Substituting for $\frac{V^2}{2g}$ the equivalent height h (the height through which the box must fall to give it the velocity V under the force of gravity) this becomes

$$U = Wh \quad \text{[2]}$$

Now suppose this energy is all absorbed in causing a deformation of any box element $= f$; this deformation will correspond to that produced by some static load F and the internal work performed within the element of the box will be $\frac{Ff}{2}$ since the force acting

[1] See "Proc. Am. Soc. Testing Materials," Vol. IV, 1904. Hatt.

increases from 0 to the maximum F, therefore,

$$Ff = 2Wh, \text{ or,}$$

$$F = \frac{2Wh}{f} \quad \ldots\ldots [3]$$

Now we have already assumed that $F = KW$ and we thus see that

$$K = \frac{2h}{f} \quad \ldots\ldots [4]$$

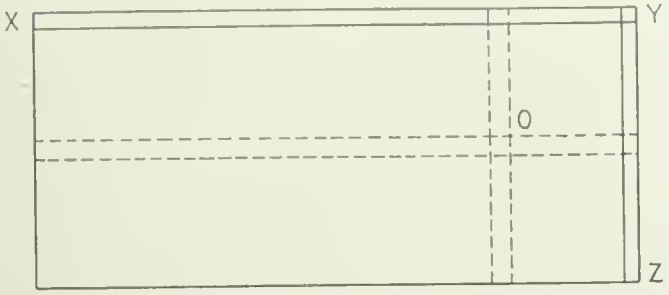


FIG. 3 ELEMENTARY BEAMS IN END OF BOX UNDER SHEAR

If the unit maximum elastic deformation of the box element be represented by e, then the total elastic deformation will be Le where L is the dimension of the box element coinciding with the direction of the force under consideration. (It might be length L, as given above, or the thickness t.) This gives, then,

$$Le = f \quad \ldots\ldots [5]$$

The quantity e will be the same for any specific material under the particular kind of stress investigated. Substituting in [4] gives

$$K = \frac{2h}{Le} \quad \ldots\ldots [6]$$

or

$$K = \frac{V^2}{Leg} \quad \ldots\ldots [6a]$$

FIG. 4 SOLID FIBER PLYBOARD BOXES AFTER A DRUM TEST

Failure by shear and tension along the edges. Remedies: (a) The use of stronger material; (b) more careful scoring; or (c) reinforced scores.

The investigation of the stresses produced in any element of a box has shown that in order to resist, without permanent set, the maximum stress set up by stopping a box with a velocity V, the maximum thickness of material in a box element should be proportional to the factor K, a constant C depending upon the proportions of the box, and the weight per unit cube of the commodity contained in the box, and the cube root of the square of the weight, divided by the unit maximum allowable fiber stress. For instance, the thickness of a face should be

$$t = \frac{KC\sqrt[3]{W^2}}{S} \quad \ldots\ldots \text{(See equation [15])}$$

Substituting the value of K as found in equation [6a] and t for L therefore

$$t = \frac{V^2C\sqrt[3]{W^2}}{tegS} \quad \ldots\ldots [7]$$

Now for any other box occupying the same relative position in the car, having the same proportions of length, width, and depth, and containing the same commodity but having a weight W_1,

$$t_1 = \frac{V^2C\sqrt[3]{W_1^2}}{t_1egS} \quad \ldots\ldots [8]$$

So that comparing them

$$\frac{t}{t_1} = \frac{\dfrac{V^2C\sqrt[3]{W^2}}{tegS}}{\dfrac{V^2C\sqrt[3]{W_1^2}}{t_1egS}} \quad \ldots\ldots [9]$$

and simplifying

$$\frac{t}{t_1} = \frac{t_1\sqrt[3]{W^2}}{t\sqrt[3]{W_1^2}} \quad \ldots\ldots [9a]$$

Multiplying both sides by $\frac{t}{t_1}$, gives

$$\frac{t^2}{t_1^2} = \frac{\sqrt[3]{W^2}}{\sqrt[3]{W_1^2}} \quad \ldots\ldots [10]$$

Extracting the square root of this gives

$$\frac{t}{t_1} = \frac{\sqrt[3]{W}}{\sqrt[3]{W_1}} \quad \ldots\ldots [11]$$

In other words, up to the elastic limit of the material in the box element two boxes of the same relative proportions should have the dimensions of similar elements in them in the same proportion as the cube roots of their gross weights.

If we have a box of length $= L$, width $= B$, and depth $= D$ we may express both width and depth in terms of the length by using the factors a and b so that

L = length, aL^2 = area of top and bottom,
aL = width, bL^2 = area of each side,
bL = depth, abL^2 = area of each end.

abL^3 = cubic capacity and $W = \dfrac{abL^3}{G}$

where $\dfrac{1}{G}$ = the weight per unit cube of the package.

The reactions of such a box under the force F may be represented by the following equations:

Face of Box [A]	Average Reactions: Per unit area [B]	Per unit length of edge [C]	Per unit length of edge [D]
Ends.....	$\frac{KW}{abL^2}$	$\frac{KW}{2L(a+b)}$	$\frac{KW}{2L(a+b)}$
Sides.....	$\frac{KW}{bL^2}$	$\frac{KW}{2L(1+b)}$	$\frac{KW}{2bL}$
Top and Bottom..	$\frac{KW}{aL^2}$	$\frac{KW}{2L(1+a)}$	$\frac{KW}{2aL}$

..[12]

(C) The equations in this column are to be used when the edges are nailed, or otherwise secured, all around, or when the material is continuous as in fiber or corrugated boxes.

(D) The equations in this column are to be used when the ends, only, of the sides, top, and bottom are nailed or otherwise fastened.

In the above equations, when K has the same value for each face of the box the entire force is considered as acting normal to that face. In such case the forces acting on any other face are zero, and the above equations therefore represent the maximum forces acting on any face or edge. (See Figs. 2 and 5).

Effects of Shear Stresses in a Face

If we assume that any face of the box is a solid plate under a uniform load of total intensity $= KW$, and also assume that a is greater than b and less than unity, and further that L, aL, and bL represent the inside dimensions of the box, then we can represent one of the faces, such as an end, by Fig. 3, so that $XY = aL$ and $YZ = bL$.

Now consider an elementary beam of unit width as existing along each of the sides XY and YZ. The points of maximum shear for each of these elementary beams will coincide at the point Y, and as both shear stresses are of the same kind the total shear at this point will be the sum of the two maximum shears for the two elementary beams.

For the elementary beam XY under the uniform load $\frac{KW}{abL^2}$ the maximum shear is

$$S_1 = \left(\frac{KW}{abL^2}\right)\left(\frac{aL}{2}\right) = \frac{KW}{2bL}$$

while for the elementary beam YZ under uniform load the maximum shear is

$$S_2 = \left(\frac{KW}{abL^2}\right)\left(\frac{bL}{2}\right) = \frac{KW}{2aL}$$

The maximum shear existing in the end will occur at the point Y, since at any other point, such as O, within the boundary of the face of the box and common to two other elementary beams parallel to the sides of the face, the shear stress in either, or both, elementary beams would be diminished according as the point O was moved towards its center. The sum, therefore, of the two shear stresses would be less than at the corner of the face.

For the maximum shear, therefore, in the end of the box

$$S_{max.} = \frac{KW(a+b)}{2abL} \quad \ldots\ldots [13]$$

The lines of rupture will start at the corners of the face, and run inwardly along each horizontal edge until they intersect.

Similarly, we would get for the shear stress in the sides of the box

$$S_{max} = \frac{KW(1+b)}{2bL} \quad \ldots\ldots [13a]$$

The shear stress at the top or bottom would be

$$S_{max} = \frac{KW(1+a)}{2aL} \quad \ldots\ldots [13b]$$

By substituting the value $\sqrt[3]{\frac{GW}{ab}}$ for L in the denominators of the above expressions they may be written in the following form

$$\left.\begin{aligned} S_c &= KC_1\sqrt[3]{W^2} \\ S_s &= KC_2\sqrt[3]{W^2} \\ S_t &= KC_3\sqrt[3]{W^2} \end{aligned}\right\} \quad \ldots\ldots [14]$$

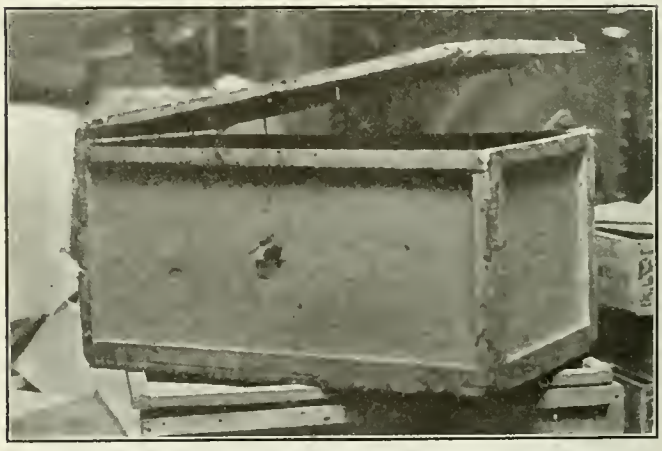


FIG. 5 FAILURE OF A PANEL BOX OF 3-PLY WOOD VENEER DUE TO NAILS PULLING OUT

Remedies: (a) The use of more nails; or (b) the use of larger nails.

In these expressions, C_1, C_2, and C_3 are constants depending upon the proportions of the width to depth of the box and the weight per unit cube. The values are

$$\left.\begin{aligned} C_1 &= \frac{1}{2}\sqrt[3]{\frac{(a+b)^3}{a^2b^2G}} \\ C_2 &= \frac{1}{2}\sqrt[3]{\frac{(1+b)^3a}{b^2G}} \\ C_3 &= \frac{1}{2}\sqrt[3]{\frac{b(1+a)^3}{a^2G}} \end{aligned}\right\} \quad \ldots\ldots [14a]$$

It will be noticed that C_1 is greater than C_2, and C_2 is greater than C_3; in other words, the shearing stress is greater in the ends than in the sides, and greater in the sides than in the top or bottom of the box.

When the box is a cube, $a = b = 1$ and $C_1 = C_2 = C_3 = \sqrt[3]{\frac{1}{G}}$ The expressions in equations [14] become

$$S_c = S_s = S_t = K\sqrt[3]{\frac{W^2}{G}} \quad \ldots\ldots [14b]$$

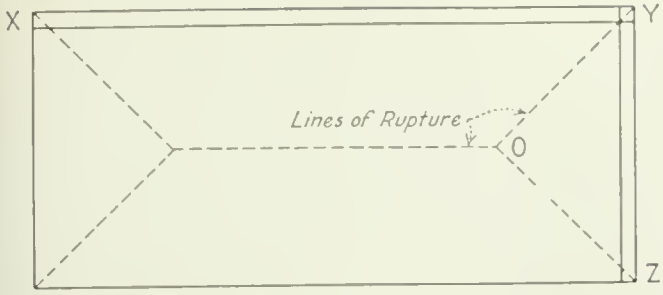


FIG. 6 ELEMENTARY BEAMS IN END OF BOX UNDER TENSION

If we denote the unit shearing strength of the material of which the box is constructed by S we can calculate the necessary thickness to withstand the maximum forces as given in equations [14] by putting $St = S_{max}$ so that for the ends, sides, top, and bottom, respectively

$$\left.\begin{aligned} t_e &= \frac{KC_1\sqrt[3]{W^2}}{S} \\ t_s &= \frac{KC_2\sqrt[3]{W^2}}{S} \\ t_t &= \frac{KC_3\sqrt[3]{W^2}}{S} \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [15]$$

These are the thicknesses necessary to resist maximum shearing stresses in the various box elements mentioned. Other stresses will also be set up within the box elements and the effects of these will be taken up in order. (See Figs. 3 and 4).

Effect of Tensile Stresses in Faces Adjoining a Loaded Face

Again assuming that any face of a box is a solid plate under a uniform load of total intensity $= KW$, it may be considered that this load would tend to tear out the face of the box and be resisted by the tensile strength of the faces adjoining it.

Let us consider that one of the faces, such as the end, has a plane passed coincident with its inner surface and cutting through the sides, top, and bottom.

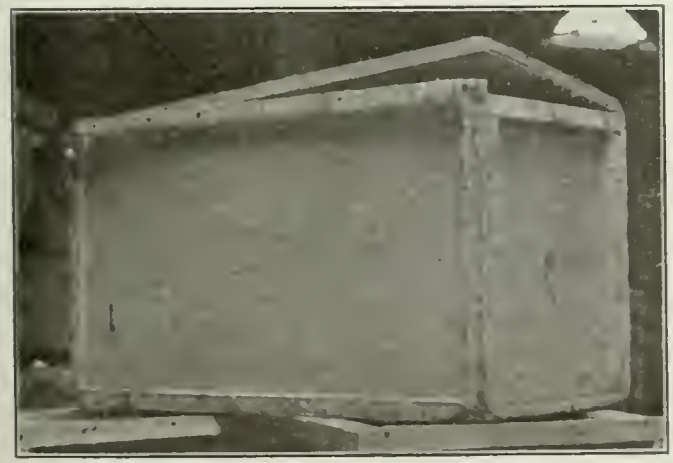


FIG. 7 FAILURE OF NAILS DRIVEN AT RIGHT ANGLES TO EACH OTHER

One of the strongest methods of securing the faces of a box. This box endured a much longer drum test than the other examples shown. Remedies: (a) The use of more nails; or (b) the use of larger nails.

The unit tensile stress around the edges of the face would be the total load, KW, divided by the sum of the lengths of the four edges. Denoting this latter by J, we have for tensile stress per unit length,

$$T_j = \frac{KW}{J}$$

Now the value of J for an end $= 2L(a+b) + t_s + t_t$, where $t_s =$ the thickness of material in the sides and $t_t =$ the thickness of material in the top and bottom. The above equation therefore becomes, when the load is considered as acting on the end

$$T_e = \frac{KW}{2L(a+b)+t+t_t} \quad \ldots\ldots\ldots\ldots\ldots\ldots [16]$$

When the load is considered as acting on one of the sides

$$T_s = \frac{KW}{2L(1+b)+t+t_t} \quad \ldots\ldots\ldots\ldots\ldots\ldots [16a]$$

Similarly when the load is considered as acting on either the top or bottom

$$T_t = \frac{KW}{2L(1+a)+t_e+t_s} \quad \ldots\ldots\ldots\ldots\ldots\ldots [16b]$$

Since the thicknesses of material in the ends, sides, top, and bottom are usually much smaller than the other dimensions we may drop the terms t_e, t_s, and t_t from the denominators of the above fractions as having little effect (the actual effect will be to introduce errors on the safe side, since the values of T_j computed thereby will be larger than they really are).

Substituting the value $\sqrt[3]{\frac{GW}{ab}}$ for L and eliminating t_e, t_s and t_t, the above equations become

$$\left.\begin{aligned} T_{fe} &= KC_4\sqrt[3]{W^2} \\ T_{fs} &= KC_5\sqrt[3]{W^2} \\ T_{ft} &= KC_6\sqrt[3]{W^2} \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [17]$$

The quantities C_4, C_5, and C_6 are constants depending upon the relative proportions of the width and depth of the box and the weight per unit cube. Their values are

$$\left.\begin{aligned} C_4 &= \frac{1}{2}\sqrt[3]{\frac{ab}{(a+b)^3G}} = \frac{C_1ab}{(a+b)^2} \\ C_5 &= \frac{1}{2}\sqrt[3]{\frac{ab}{(1+b)^3G}} = \frac{C_2b}{(1+b)^2} \\ C_6 &= \frac{1}{2}\sqrt[3]{\frac{ab}{(1+a)^3G}} = \frac{C_3a}{(1+a)^2} \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots [17a]$$

The first expression is the greatest, the second next, and the last the smallest of the three; none of them is as great as C_1, C_2, or C_3.

When the box is a cube, as before, $a = b = 1$ and $C_4 = C_5 = C_6$ and equations [17] become

$$T_c = \frac{1}{4}K\sqrt[3]{\frac{W^2}{G}} \quad \ldots\ldots\ldots\ldots\ldots\ldots [17b]$$

which is only $\frac{1}{4}S$ as given in equation [14b].

Denoting the unit tensile strength of the box material by T we can calculate the necessary thickness to

resist the tensile stresses as given in equations [17] by substituting $Tt = T_s$. This gives

$$\left.\begin{aligned} t_e \text{ or } t_e &= \frac{KC_4\sqrt[3]{W^2}}{T}, \text{ load on either end} \ldots \\ t_e \text{ or } t_t &= \frac{KC_5\sqrt[3]{W^2}}{T}, \text{ load on side} \ldots\ldots\ldots \\ t_e \text{ or } t_s &= \frac{KC_6\sqrt[3]{W^2}}{T}, \text{ load on top or bottom} \end{aligned}\right\} \quad [18]$$

It is to be noted that the tensile stresses, investigated above, while induced by the load on a face do not involve any of the material of that face but are entirely supported by the material of the four adjoining faces. For the determination of the tensile stresses within the material of a loaded face recourse must be had to the theory of the moments of forces.

Effects of Cross Bending at Edge of a Loaded Face

Assuming, as before, that the face of a box is represented by Fig. 6, in which for an end, $XY = aL$ and $YZ = bL$, let us again consider an elementary beam along each of the edges XY and YZ. Assume that these two beams are fixed at each end and loaded with a uniform load of intensity $\frac{KW}{abL^2}$.

The maximum external moment for each beam will occur at the ends and for the beam XY will be

$$M_1 = \frac{KWa}{12b}$$

The maximum external moment for the beam YZ will also be at its ends and will be

$$M_2 = \frac{KWb}{12a}$$

Both of these moments act simultaneously at the point Y and are at right angles to each other; the real external moment therefore acting at the point Y will be the resultant of these two moments and will be

$$M_{max}^2 = M_1^2 + M_2^2$$

Substituting the values of M_1 and M_2 and extracting the square root we get, for an end,

$$M_{max} = \frac{KW}{12ab}\sqrt{a^4+b^4} \quad \ldots\ldots\ldots\ldots\ldots\ldots [19]$$

The plane of this moment is at right angles to the plane of the end and intersects it along a diagonal, passing through the point Y. For the sides the maximum moment will be

$$M_{max} = \frac{KW}{12ab}\sqrt{1+b^4} \quad \ldots\ldots\ldots\ldots\ldots\ldots [19a]$$

Similarly for the top or bottom

$$M_{max} = \frac{KW}{12ab}\sqrt{1+a^4} \quad \ldots\ldots\ldots\ldots\ldots\ldots [19b]$$

The internal stress moment, or moment of resistance, must be equal to the external maximum moment, or

$$M_{max} = \frac{TI}{c}$$

where T = the elastic unit tensile stress at the outer surface of the face (it is horizontal in direction) and $\frac{I}{c}$ is the section modulus. For a rectangular beam of unit width and depth $= t_e$, for an end, this will be

$$\frac{I}{c} = \frac{t_e^2}{6}$$

For the maximum horizontal stresses in the ends, sides, and top or bottom, respectively, this will give

$$\left.\begin{aligned} T_e &= \frac{KW}{2abt_e^2}\sqrt{a^4+b^4} \\ T_s &= \frac{KW}{2abt_s^2}\sqrt{1+b^4} \\ T_t &= \frac{KW}{2abt_t^2}\sqrt{1+a^4} \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots [20]$$

FIG. 8 PUNCTURED PANEL OF 3-PLY WOOD VENEER BOX

Failure due to lack of cross-bending strength and a combination of shear and tension stresses. Poor gluing of the plies contributes materially to this class of failures. Remedies: (a) The use of thicker veneer; (b) the use of stronger wood; (c) the use of more plies; or (d) careful gluing of the plies.

For the thickness of material necessary to resist these stresses when T = the unit tensile strength of the material of which the box is made, $T = T_e = T_s = T_t$ and

$$\left.\begin{aligned} t_e &= \sqrt{\frac{KW}{2abT}(a^4+b^4)^{1/2}} \\ t_s &= \sqrt{\frac{KW}{2abT}(1+b^4)^{1/2}} \\ t_t &= \sqrt{\frac{KW}{2abT}(1+a^4)^{1/2}} \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots [21]$$

These equations may be written in the forms of

$$\left.\begin{aligned} t_e &= \sqrt{K}.C_7\sqrt{W} \\ t_s &= \sqrt{K}.C_8\sqrt{W} \\ t_t &= \sqrt{K}.C_9\sqrt{W} \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots [22]$$

In these formulas the quantities C_7, C_8, and C_9 are constants whose value depends upon the material and proportions of the box and may be determined from equations [21]. (See Figs. 6 and 7).

Application of Charts in Industry—II*

Management Data Summary—Number 24†

By DAVID B. PORTER

Assistant Professor of Industrial Engineering, New York University

Index Number
658.53 Graphic charts

IN a previous article "historical charts" were discussed. We will now consider the application of charts which show the frequency with which events occur under conditions of a non-historical nature. Such "frequency charts[1]" are a cross-section of a phenomena at a single point of time, or of totals through a period of time.

A manufacturer who distributes his product over a wide territory will be helped by knowing his per capita sales in cities or districts of different sizes. The range of population is divided into a number of equal groups or classes which are plotted as a series along the horizontal axis, and the per capita sales for the cities or districts whose populations fall within the limits of a group are averaged, and the number plotted on the vertical line drawn through the center of the group. These magnitudes may be represented by a series of vertical bars or a staircased curve or by the polygon obtained by connecting the plotted points by straight lines.

Fig. 13 is a simple frequency chart showing the actual sales of an article manufactured by an industry which makes several sizes in each of its lines of product. The sizes, which represent the independent variable, are laid off on the horizontal axis, while the sales for the two years given are laid off in the vertical direction, and in this figure are plotted not at the center of the spaces between the vertical lines, but directly on the verticals or ordinates, representing each size. The reason for this is that in the former case the vertical lines represent group limits and the frequencies throughout a group can only be represented by a point plotted at the center of the group, while in Fig. 13 the vertical lines represent sizes at which only it is possible for frequencies to occur. Strictly speaking, for this same reason the frequencies in Fig. 13 should be represented by a series of disconnected vertical bars. However, it would be almost impossible to make a comparison between the two years if bars were employed. We therefore connect the points by straight lines, which gives us two curves that may be compared. It must be remembered that the lines in this case between points do not represent any frequencies, but indicate only a change in the direction of the frequencies at the specified points.

The distribution of sales by sizes of another line of the same kind of goods is shown in Fig. 14. Since the absolute sales differed greatly in quantity for the two years it would have been difficult to compare the distribution characteristics if the absolute quantities had been charted. Instead, all quantities have been reduced to percentages of the totals for each year, which brings the curves close together and establishes their similarity. The mode is defined as the size of the independent variable where the greatest number of frequencies occur, hence it can be determined by the highest point of the frequency curve.

The curve of the cumulated series is called the "cumulative curve" or "ogive". Since a frequency series

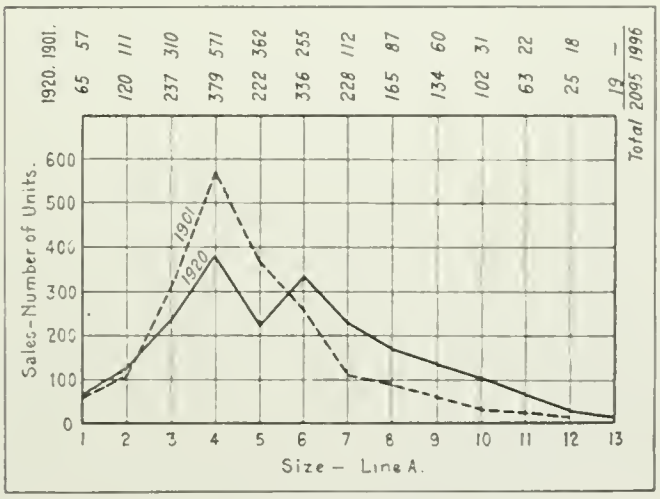


FIG. 13 A SIMPLE FREQUENCY CHART
This chart shows the comparative distribution of absolute sales for two years of an article manufactured in different sizes.

may be cumulated from either end, the ogive has two possible positions. The one shown in Fig. 14 begins the cumulation at the lower end of the series, and is therefore called a "less than" cumulation, because we read that for 1920 the sales for size 4 and all sizes less than 4 amounted to 90.5 per cent of the total sales. The other position is for the "more than" cumulation where the series is cumulated from the higher end. The curve for this begins at the upper left corner and ends at the lower right corner of the chart. The mode may also be read from the ogive where it is the steepest, as size 3 for the case shown. Since two ogives interfere with each other but slightly, and show the characteristics of distribution, as well as the cumulation of the series at any point, they are perhaps better than the simple chart for showing frequency data. If

* For the first of these two articles on charts see MANAGEMENT AND ADMINISTRATION, January 1924, p. 65.

† This article is one of a series which gives in concise, factual form standardized methods and accepted practice generally applicable in industrial operations.

[1] For a general reference book on charting methods "Charts and Graphs" by Karl G. Karsten is recommended.

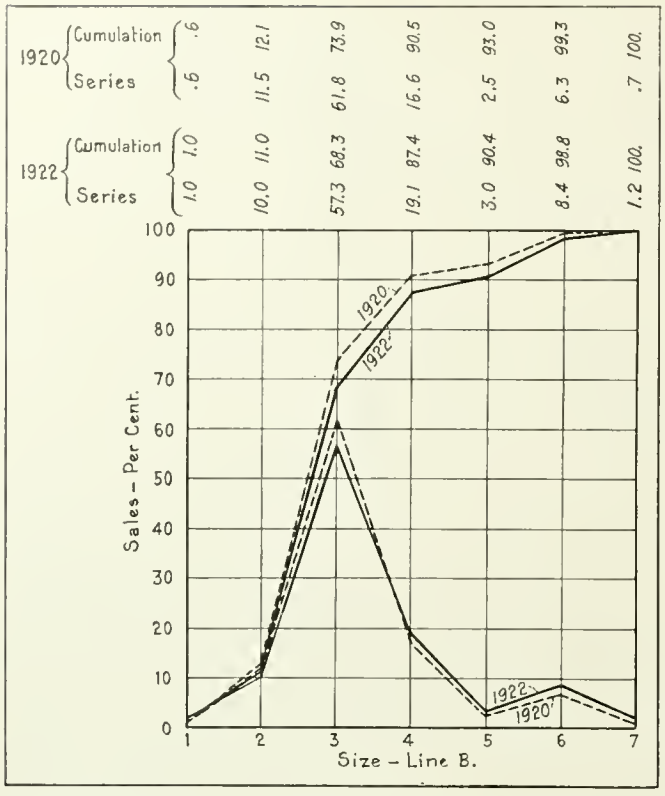


FIG. 14 FREQUENCY CHART OF A SIMPLE AND CUMULATIVE SERIES
This chart shows the comparative distribution of relative sales for two years of an article manufactured in different sizes. Cumulative figures are percentages of totals for specified size, and sizes less than the specified size.

related series are reduced to percentages, and the cumulative curves of each are drawn on separate semi-transparent charts that have standard fields, they may be compared by "light analysis".

Another subject which is very important and always demands a good deal of study is the distribution of wages in a manufacturing establishment by classes of workers. The wage range is divided into groups, and the group limits plotted on the horizontal axis, while the number of workers of a given class whose wages fall within each of the groups is plotted vertically in the spaces between the group limits. The essential thing is to have equal groups. When the range of data is very wide, and it is not practical to maintain the same size of group throughout the series, the data must be reduced to "equivalent groups" of the same size. For instance, it might be desirable to divide the lower and middle range of a weekly wage-scale into two-dollar intervals, whereas to extend this into the higher and more unused reaches of the wage range would make the series too long and give many groups without any frequencies. For this part of the range the interval can be increased to, say, five dollars, but the number of frequencies or workers receiving wages falling within the five-dollar groups must be divided by two-and-one-half in order to reduce the number to a number which is equivalent to a two-dollar interval. When the cumulative curve is used it is not necessary to have equal group intervals, the vertical lines are spaced at distances proportional to the sizes of the groups. This is another advantage of this type over the simple frequency curve.

Gantt Charts

Thus far in this and the previous article we have considered the graphical presentation of historical records and other statistical data. We turn now to the group of charts dealing with the present and immediate future, charts which aid those who are responsible for the discharge of routine affairs because they show what is to be done and who should do it. They find their application in all levels of an industrial establishment from the worker to the managing executive.

Machine Record Charts

Since all idle machines in a shop are non-productive, a study of the reasons for their idleness will help to reduce it within reasonable limits. Fig. 15 is a machine record summary chart of all departments. The day is divided on the chart into four parts of equal width, each part representing 2 hr., plus a fifth part which is narrower and may represent the ninth hour or a fraction of an hour. The bars are drawn to represent the cumulative amount of time the machines in each department operated for the week, and the distances from the ends of the bars to the end of the week indicate the amounts of idleness. The reasons for the idleness are written by symbols in these spaces. The letter *O* stands for lack of orders, *H* for lack of help, *R* for repairs, *P* for power, and others in like manner.

More important than the summary charts for the manager are the detail record charts for the foreman and superintendent. These are usually kept in the foreman's office and entered daily so that he may

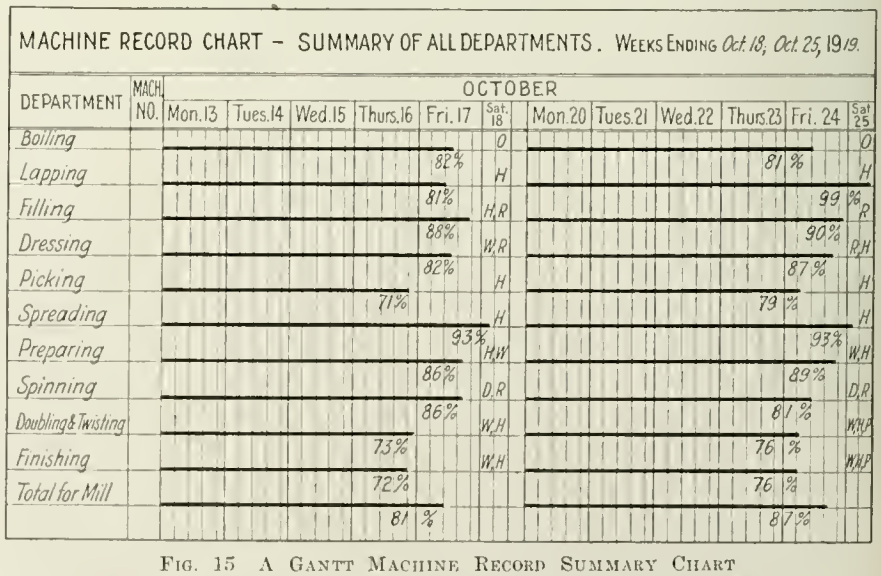


FIG. 15 A GANTT MACHINE RECORD SUMMARY CHART
This chart shows the amount of time the machines of each department as a whole operated.

take the proper action to relieve those causes for idleness which come within his power. The greatest detail is shown by a bar for each machine in the department, but often a bar for each group of similar machines is sufficient and is much more condensed. The daily running time of machine or group is represented by a light line drawn from the beginning of the daily space through as many hours as the machine or group operated. The symbol for idleness is placed in the space between the end of the line and the end of the day. At the end of the week the daily lines are summed up and the heavy cumulative line drawn to represent the total running time for the week. Many causes for idleness that are entirely outside of the foreman's control are brought to light, and the responsibility placed wherever it belongs.

Mr. Gantt was a firm advocate of the theory that the cost of goods should not bear the cost of machine idleness, but that all idleness costs should be segregated and carried to profit and loss. Entirely incidental to the main reasons for this, there is much advantage to be gained from segregating idleness costs so that they may be used as a guide to better management instead of being covered up in the general expense burden. Fig. 16 is an idleness expense chart which shows by the bars the per cent of time each group of machines ran, and the amount of idleness expense in money for each of the several causes of idleness. These charts may be made for any period of time, but the month, or four- and five-week periods are more commonly used. The effect of translating machine idleness into money is to stress management and responsibility.

Progress Charts

The widest application of the Gantt chart has been reached in the measurement of performance against a schedule. When used in this capacity a different interpretation attaches to the spaces and bars. Since all activities can be measured by the length of time required to perform them, the space of the chart representing the unit of time can be made to represent the amount of activity which should have been performed during that time. The bars measure the amount of activity which has been performed. In order to chart progress by this method it is necessary, first, to establish a schedule, which is nothing more than a rate of doing work, as so many units of production or sales per day, week, or month according to the period chosen for the time unit. It is not necessary for the schedule to remain the same throughout the chart; changes are indicated by the figures appearing within the time spaces. When space permits the cumulative figures are entered at the right side of the space so that the total amount may be read at the end of any time interval.

Fig. 17 is a progress chart of orders and production. The month is the time unit and the schedule for each month is indicated by the figures appearing within the monthly spaces. These spaces are divided by light lines into five equal parts in order to facilitate charting the performance as a percentage of the monthly schedule. The bars represent the performance in number of pounds of the schedule indicated within each space. The end of the thin portion of the first bar is about 8/10 of the way across March, therefore new orders are added to the end of this bar at the rate of 3500 lb. per month, so that 700 lb. more would bring this line to the end of March. When it enters April the schedule drops to 2800 lb., and new additions are added at this rate. At the same time deliveries represented by the heavy portion of the line are still in February and are progressing at 2800 lb. per month. This chart is posted weekly. The week's new orders and deliveries are divided by their respective schedules, and the per cent of the month's schedule performed during that week is added to the ends of the bars. The chart is blue-printed and copies sent each week to the superintendent, manager, and sales department. A white vertical line is drawn on each print at a point which represents the end of the week to which the chart is entered. It is shown in the figure by a dotted line. From this it is easy to see whether performance has lived up to its schedule.

When charts are prepared for blue-printing they

WORKING PERIOD 5 WEEKS ... DAYS ... HOURS PERIOD ENDING Sept. 3 1921 Lower Throwing MILL

TOTAL MACHINE EXPENSE USED ..... TOTAL UNUSED $233.32 TOTAL MACHINE TIME USED 93.5 PER CENT TOTAL CREDIT .0 PER CENT

SYMBOL	DEPARTMENT OR MACH. CLASS	PER CENT OF TIME MACHINES RAN (10 20 30 40 50 60 70 80 90)	DETAILS OF EXPENSES OF IDLENESS DUE TO: Lack of Orders Note 1	Lack of Help Note 2	Lack of Material	Caught up to Next Dept.	Repairs	TOTAL	REMARKS
	Total		50 85	178 56			3 91	233 32	
	Winders			101 40				101 40	
	Doublers			43 38				43 38	
	Spinners		50 85	93				51 84	Note 1 This Expense is incurred because this Machine is used for Special Coarse Size and is due to Shortage of this Size
	Hosiery Spinners			8 28			3 91	12 19	
	Twisters								
	Transferring			16 11				16 11	Note 2 Lack of help does not mean an Actual need of Help but means Workers are out at Intervals
	Stretchers			53				53	
	Reels			7 87				7 87	

FIG. 16 A GANTT IDLENESS EXPENSE CHART

This chart shows the reason for, and expense of machine idleness, and the per cent of time machines operated.

should be drawn on a good quality of translucent paper. All ink lines should be drawn with india ink, and typewritten matter should be backed with carbon paper so that the carbon paper faces the reverse side of the chart. This will make the typewritten matter blue-print very well.

The three conditions of goods delivered, goods processed, and unfilled orders, are shown in condensed form by the method of superimposing bars as illustrated in Fig. 17. If more than three or four bars are superimposed in this way much of the clearness is lost. One of the great advantages of the Gantt chart is its adaptability for showing several conditions for each of the 20 to 30 subjects on the same chart. This places it in a superior position to the rectangular chart, where time is plotted on the horizontal axis and

PROGRESS CHART SHOWING SCHEDULE, ORDERS AND PRODUCTION.

NOTE: If deliveries are ahead of or behind schedule, delivery promises should be advanced or set back accordingly.)

ENTERED TO *Feb. 18*, 1922.

	1922 Jan. 21-31	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
SINGLES; #1 Quality	934	2800	3500	2800	2800	3500	2800	2800	3500	2800	2800	3500
#2 Quality	467	1400	1750	1400	1400	1750	1400	1400	1750	1400	1400	1750
#3 Quality	234	700	875	700	700	875	700	700	875	700	875	700
PLY, YARNS; #1 Quality Fine	237	710	888	710	710	888	710	710	888	710	710	888
Medium	380	1140	1425	1140	1140	1425	1140	1140	1425	1140	1140	1425
Coarse	237	710	888	710	710	888	710	710	888	710	710	888
#2 Quality Fine	94	280	350	280	280	350	280	280	350	280	280	350
Medium	377	1130	1413	1130	1130	1413	1130	1130	1413	1130	1130	1413
Coarse	177	530	663	530	530	663	530	530	663	530	530	663
#3 Quality Fine Medium and Coarse	197	590	738	590	590	738	590	590	738	590	590	738
X Grade	267	800	1000	800	800	1000	800	800	1000	800	800	1000

KEY: Figures Indicate Monthly Schedule.
Unfilled Orders.
Delivered.
Unfilled Portion of Line Indicates Amount Processed but not yet Delivered.

FIG. 17 A GANTT PROGRESS CHART FOR SCHEDULE, ORDERS, AND PRODUCTION, SUMMARIZED BY PRODUCT
This chart shows the amount of unfilled orders, also the amount delivered and processed according to schedule.

amount on the vertical axis, on which type of chart only one subject may properly be drawn.

Fig. 18 is a detail progress chart of orders and production for one of the subjects shown in Fig. 17. The same printed form is used with the addition of columns ruled by hand at the left to suit the particular requirements. Furthermore, the time space is used to represent a week instead of a month. The total schedule for all orders of No. 1 quality fine is 178 lb. per week which is written across the top of the chart. The row of figures directly beneath is the allotment of orders against the schedule. The orders are listed as they are received and are laid out by angles to commence in the first week which has not already had its quota assigned to it. Progress on the orders is shown by the heavy bars. Each bar is extended at the rate indicated by the schedule of its order.

In many plants it is necessary to support any progress chart where orders are scheduled, by a detail machine layout chart where work is assigned to each machine or group of machines. No illustration is given here, but the principle is the same. Jobs are laid out for each machine on a schedule based upon the machine's capacity. The daily space may be made large with the divisions for hours shown, or small and without hourly divisions as the case may require.

In the course of manufacturing many articles on a continuous basis, it frequently happens that some of the component parts are not made at the plant, but are purchased on schedule from outside sources. The two functions of purchasing and manufacturing may be conveniently co-ordinated by recording their progress on one chart so that each is shown in its proper relation to the other. This helps the superintendent to exercise a more complete control over the supply of all parts which make up the finished article.

An example of such a chart is shown in Fig. 19. This is also drawn on the same form as Fig. 17 with the adjustment of columns at the left made by hand. The first column shows the plant manufacturing order number, the material or part name, and the contractor when parts are purchased from outside. The second column contains the purchase order number, and the third column contains the number on order. It was desired to show the total number of parts which had been manufactured at the plant or had been received on purchase order to date. Inasmuch as there was not sufficient room to write the cumulative totals at the end of each weekly space, the first column of the time field was converted from its use as a time space into a column of figures showing the total number completed. Since these figures are changing each

week they cannot be entered in ink. Entering them in pencil is not satisfactory because the paper becomes worn out with the erasing and the pencil does not print clearly. The figures are entered in ink on a separate strip of chart paper which is printed independently and pasted on the printed chart in the proper place.

Although the cut of Fig. 19 was altered to make the "Total Completed" column stand out clearly for the purposes of presentation, in the original chart it was actually the first column of the time field. (Three columns occurring at the right in the time field have also been omitted to save space). The reason for mentioning such details is to show how a standard form may be adapted to meet special requirements.

On the first line is charted the progress of the completed article, and the title or stub as it is called is begun at the extreme left of the first column. The second line shows the progress of the bullets which compose an assembly of parts. The stub for this is indented from the left so that it appears beneath but not on a marginal line with the completed article of which it is only a part. Since the bullets are made up of three independent parts—cores, jackets, and casings—the stubs for these parts are still further indented so that they appear beneath the bullets but not on an equal margin with them. By such a method of marginal indentations, or "Brief" form, a complex assembly may be arranged for charting so that all parts are seen in their proper relation to each other.

The lower group of stubs is a repetition of the upper group, but is for a different work order which is laid out to follow the first one. The weekly schedule is written in the first space and does not appear again because the same schedule continues throughout the chart. The weekly performance is shown by the light lines. Their length indicates the percentage of the week's schedule fulfilled. The heavy lines are the cumulative or progress lines and are equal to the sum of the light lines. Bullets for a part of this order are being made at the plant, for which cores are being purchased from outside, and jackets and casings are being made at the plant. In order that the manufacture of bullets may be kept up to schedule these three parts must be up to date. The date is indicated by a V at the top of the chart placed at the end of the week through which the chart is posted. The assembling of the completed bullet necessitates the withdrawal from stores of the cores, jackets, and casings which are parts of the bullet, therefore the progress line of the completed bullet represents also the consumption or used

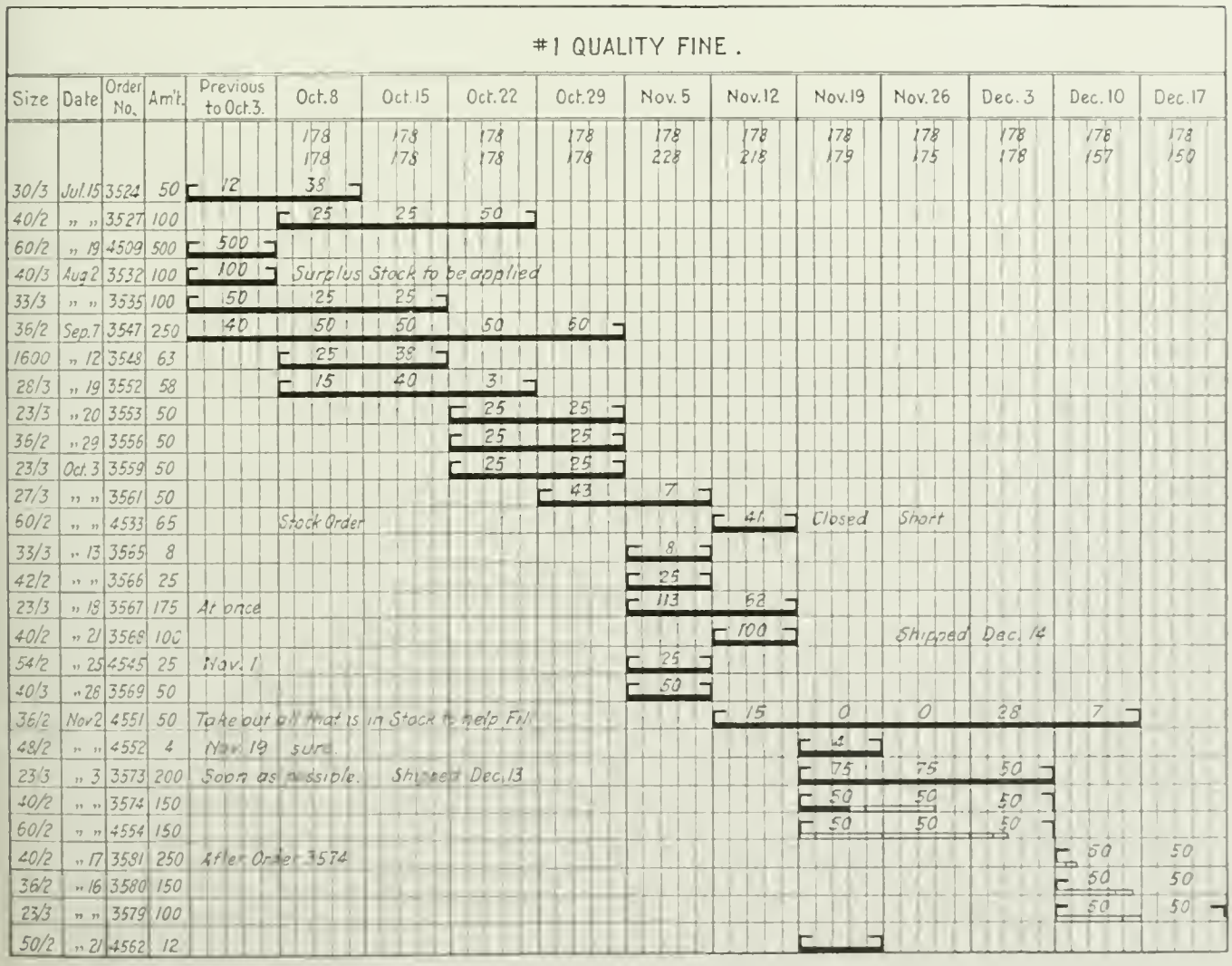


FIG. 18 A GANTT DETAIL PROGRESS CHART FOR A SINGLE PRODUCT
This chart shows the layout, schedule, and production of each order.

CONTRACTS FOR AND MANUFACTURE OF ARMOR PIERCING AMMUNITION AND COMPONENTS

Work Order, Material & Contractor.	Purchase Order	No. on Order	Total No. Completed	Week Ending May 4	May 11	May 18	May 25	June 1	June 8	June 15	June 22
17M1758 Complete Rounds Loaded		900M	747,560	108 M							
Bullets Complete Ma'eat Plant		900M	858,357	102 M							
Cores to Plant from S.G. Co.	1188 A	450M	450,000	Completed							
Cores to Plant from M.P. Co.	7597	200M	82,875	Completed	Short						
Cores to Plant from M.F. Co.	7000	250M	250,500	108 M							
Jackets Made at Plant		900M	1,100,193	108 M							
Casings Made at Plant		900M	868,650	108 M							
18M 285 Complete Rounds Loaded		7,500M	62,250						100 M		
Bullets Complete Made at Plant		3,500M	81,007					102 M			
Bullets Complete from M.S. Co.	13,275	4,000M	0								
Cores to Plant from S.G. Co.	9,853	3,500M	385,000					108 M			
Jackets Made at Plant		3,500M	264,004					108 M			
Casings Made at Plant		3,500M	255,873					108 M			

FIG. 19 A GANTT PROGRESS CHART CO-ORDINATING PURCHASING AND MANUFACTURING
This chart ties together purchasing and production of parts for final assembly on a schedule basis.

line for the component parts. It therefore follows that the difference in length between the bullet progress line and each of the three component lines indicates the amount of these parts on hand. Since the bullet and its component parts begin at the same point of time, their difference in length, and hence the amount on hand, can be read by the difference in the position of the ends of the lines. Each of the component lines must be referred to the bullet progress line which measures their common consumption.

Fig. 20 is a progress chart for the manufacture of a fuze and in principle is the same as Fig. 19. It is carried out in greater detail and is posted daily instead of weekly. The same system of marginal indentations is used to set off the assemblies and their components. The necessity for this is more apparent in a chart of this complexity when it is desired to compare the progress of any component with the progress of the assembly of which it forms a part. The weekly spaces are divided into six parts for the days of the week,

PROGRESS SHEET FOR ....Med..Cal..Base.Det..Fuze.....

	Order Number	Number Pieces	Daily Schedule
Assemble Fuze	17 S 25	25,000	1000
Man'f'r Fuze Body		25,000	1000
Man'f'r Rear Plug		25,000	1000
Man'f'r Front Plug		25,000	1000
Man'f'r Front Plug Disc		25,000	1000
Man'f'r Front Plug Set Screw		25,000	1000
Man'f'r Rear Plug Set Screw		25,000	1000
Man'f'r Det. Stock Set Screw		25,000	1000
Assemble Detonator		25,000	1000
Man'f'r Det. Stock		25,000	1000
Man'f'r Det. Casing		25,000	1000
Man'f'r Brass Plug		25,000	1000
Assemble Percussion Primer		25,000	1000
Man'f'r Primer Body		25,000	1000
Man'f'r Primer Bridge		25,000	1000
Man'f'r Primer Cup		25,000	1000
Man'f'r Paper Disc		25,000	1000
Man'f'r Brass Disc		25,000	1000
Assemble Percussion Plunger		25,000	1000
Man'f'r Housing		25,000	1000
Man'f'r Lock Pin		25,000	1000
Procure Resist. Spring		50,000	2000
Man'f'r Resist. Spg Housing		50,000	2000
Assemble Body		25,000	1000
Man'f'r Plunger Body		25,000	1000
Man'f'r Firing Pin		25,000	1000
Man'f'r Fir. Pin Fulcrum		25,000	1000
Man'f'r Safety Pins		50,000	2000
Procure Safety Springs		50,000	2000

FIG. 20 A GANTT PROGRESS CHART FOR CONTROL OF OPERATIONS
This chart shows when work is to be started on each operation, and the progress of work on the last operation for each component part of a fuze.

which requires the use of a different form. If Saturday is only half a full working day the daily schedule for Saturday is reduced accordingly, so that a production of 500 parts on that day is charted as a full day's work. An angle and a figure 1 indicate the day on which the first operation is to start, and operations 2, 3, 4, etc., are to start on the days in which these figures are written. When the first operation is started the heavy progress line is drawn half-way across the daily space, and when the second operation is started the bar is drawn half-way across the daily space indicated by the figure 2. When all of the operations are started we have a series of dots whose lengths mean nothing, but simply indicate that work has commenced on those operations.

When the first operation has been completed for the entire order the bar is extended across the space to join with the second portion of the bar. This procedure is carried out for all but the last operation for which production is charted in the regular way, that is, the bar is extended each day by the amount finished on the last operation so that the progress of the finished part can be seen. The light lines drawn through the daily spaces indicate the amount done on the last operation each day. The advantage of such a chart is the ease with which work may be planned in advance so that operations are performed in the proper time to insure an uninterrupted assembly of the finished article. A chart of this kind is posted in pencil and usually kept in the superintendent's office—as it is primarily intended for his guidance. A summary chart may be prepared in ink and posted weekly showing the progress of the completed fuze together with other articles being manufactured. Prints may be taken of this and distributed to the manager and others interested in the production of the plant.

When further detail is required showing the progress of the individual operations a separate line is given to each one. If Fig. 20 had been drawn in this way 69 lines would have been required in order to show the progress of every operation on each piece. For this reason the condensed form is recommended unless the greater detail is necessary.

The third type of Gantt chart measures the performance of the workers, as shown in Fig. 21. The lines and bars do not measure time as in the machine record chart, but are a measure of the amount of work which has been done according to the task, which is the same in principle as the schedule of work in the progress chart. Thus, if the time allowed per piece is one-tenth of an hour, and an operator does 90 pieces in a day, his performance is measured by a light line drawn through 9 hr. of the daily space. Where the heavy line doubles back under itself at the end of the week it shows that the operator has exceeded the task. Whenever the operator fails to perform a day's work, a symbol explaining the failure is placed in the space between the end of the daily line and the end of the daily space. Every operator's work is posted daily preferably in the foreman's office, and the chart reviewed by the foreman and task department so that proper action may be taken to remove the causes of failure. The cumulative line is drawn at the end of the week and the chart is printed, copies being sent to the superintendent and task department, and the original held by the foreman. When the chart is thoroughly understood it is welcomed by the workers who look upon it as a means of having the measure of their work fairly recorded, and the causes of failure brought out which in the majority of cases are entirely no fault of theirs. It is a means for promoting democracy and fixing responsibility in a shop.

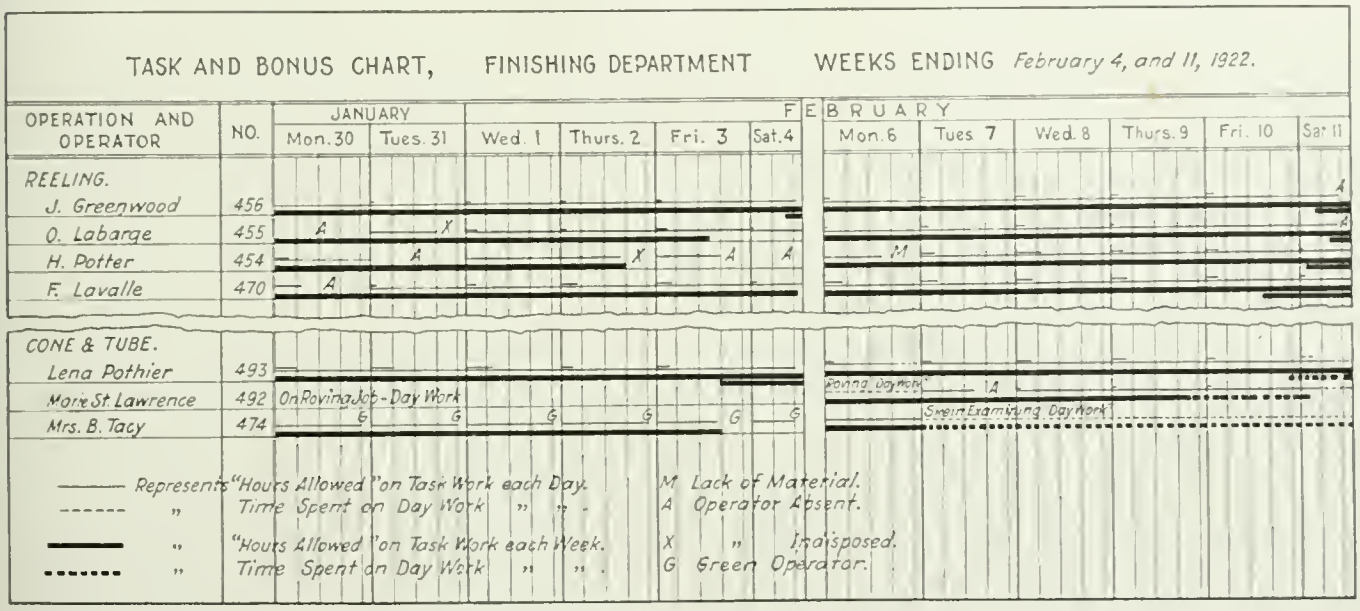
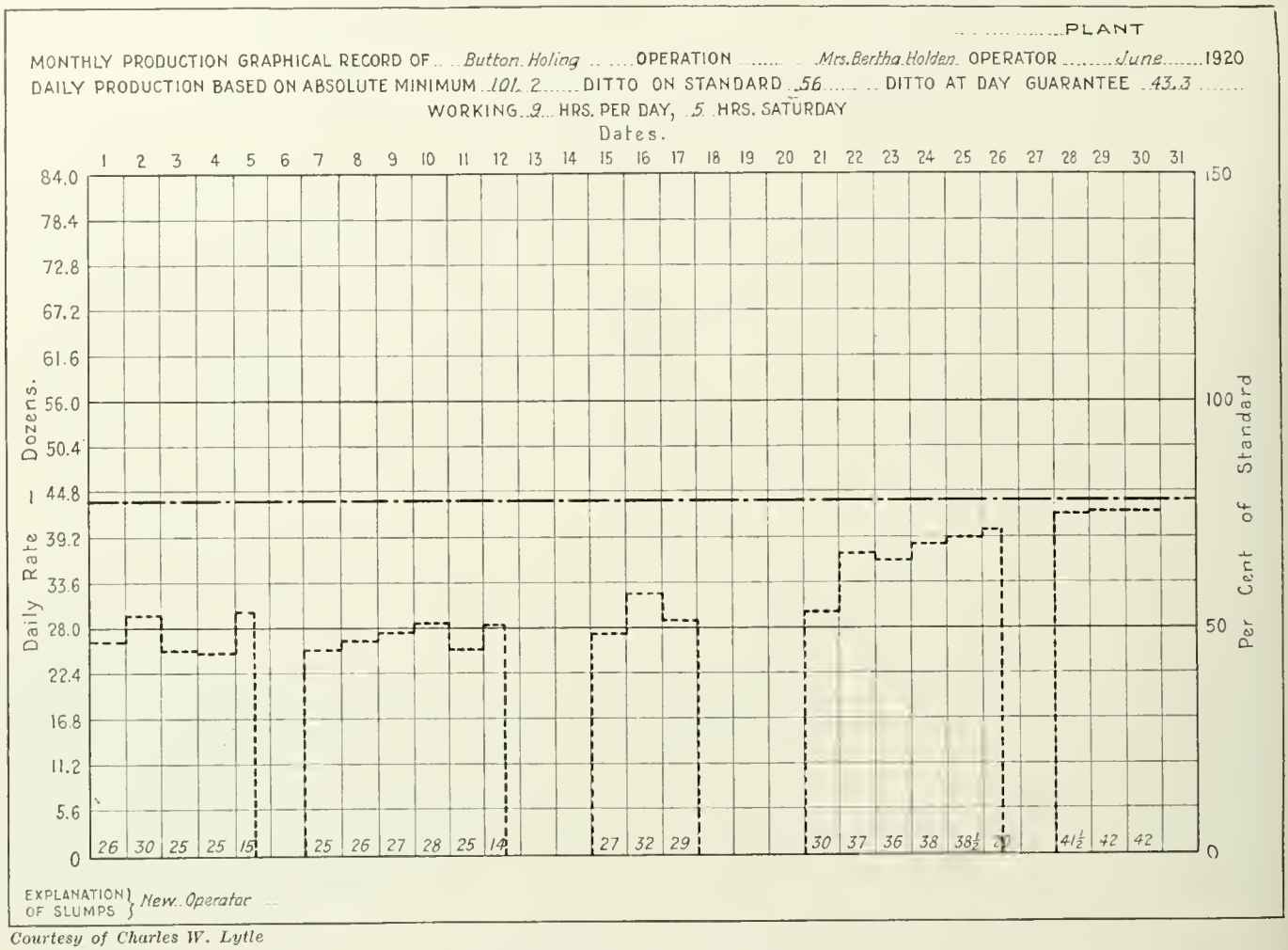


FIG. 21 A GANTT MAN RECORD CHART OF WORK DONE BY INDIVIDUAL EMPLOYEES
This chart shows the daily and weekly performance of operators on work for which standards have been set.

It should be realized that much attention has been given to standardizing the form of the Gantt chart so that the number of forms could be kept at a minimum. It is seen that one form suffices for the man record and machine record chart. The form of Fig. 17 may be used for showing progress where the time unit is



Courtesy of Charles W. Lytle

FIG. 22 A SPECIAL MAN RECORD CHART OF THE OUTPUT OF A SINGLE EMPLOYEE

This chart is used for educational purposes. The vertical columns represent to the operator piles of work done each day. The horizontal dash-dot line shows the performance to be attained by the employee before she can be put on piece work.

either the day, week, or month, and where performance is posted as a percentage of the schedule. Fig. 20 requires a third form in which the week is divided into six parts for the daily posting of progress. The charts used for laying out work for machines are usually designed to meet the special conditions of the particular shop, but the three forms indicated above are sufficient on which to chart the majority of the activities which are suitable for being shown by this method. There are standard Gantt forms printed and for sale on the market, so that these should be considered before proceeding to adopt a special form.

Fig. 22 is not a Gantt chart, but is another form of an operator's chart which has been successfully used for educational purposes. It is a month's record of one operator's performance. The amount of performance in dozens is read from the scale at the left and its percentage of standard is read on the right-hand scale. The daily amount is represented by vertical bars which are supposed to represent piles of work done, and the actual number is placed within and at the bottom of the bar. A horizontal line is drawn at 43.3 dozen, the amount of production which, when multiplied by the piece price, will yield an earning equal to the day guarantee. When the bars are below this, the difference represents the amount by which the operator fails to earn the day guarantee. In the original chart the bars and horizontal line are drawn in red. Except for educational purposes the Gantt chart is recommended because it permits the record of 20 to 30 workers being shown on one chart, and enables comparisons to be made between them which would be impossible by the other method.

The three types of Gantt charts were designed to answer three fundamental questions in the problem of management. To use Mr. Gantt's own words:[2] "Are all the machines being used? If not, why not?" (See machine record charts.) "If running, are they doing the work most needed? If not, why not?" (See progress charts.) "If running and doing the work most urgent, are they doing it as rapidly as they should? If not, why not?" (See man record charts.)

For a brief exposition of these three charts the reader's attention is called to the article by the late Mr. Gantt just referred to above, and for a comprehensive study it is suggested that he read, "The Gantt Chart," by Wallace Clark, which contains many applications, with the technique for their presentation.

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[2] See *Industrial Management*, July 1919, "Organizing for Work," by H. L. Gantt.

(Concluded in this issue.)

The Industrial System and the Price System

II—Economic Problems of Industrial Organization

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Index Number
338.5 Prices
33 Economics

IN the preceding article[1] of this series the factors of production were described and the nature of the chief economic processes indicated, with reference throughout to the production and distribution of goods. Actual economic goods are, of course, of primary importance in economic life, for in the last analysis the efficiency of our economic system depends upon the quantity of goods produced and the degree of equality attained in the distribution of these goods, with due regard to the maintenance of necessary capital equipment. But to facilitate the production and distribution of goods man has found it necessary to employ a medium which of itself may satisfy no economic need nor serve any final purpose. This medium is money.

The Functions of Money

The direct economic functions of money are familiar and require no detailed explanation. Its primary services are performed as a standard of value and as a medium of exchange, a yardstick for measuring the value in exchange of economic goods of all sorts, and a universally desired medium for the possession of which men will part with their products in order that they may secure others. In a ruder and simpler system these services might be viewed as of minor importance, subordinate to the main economic processes concerned with the production and consumption of goods. But with the growing complexity of the economic system—the ever-increasing division of labor and specialization of function, the constantly greater importance of exchange and the resulting interdependence of individuals and economic units—this medium has come to play a commanding rôle in economic life. Instead of occupying a merely incidental place it has become a factor affecting vitally, both for good and ill, every economic process. Economic activities have come to be carried on almost universally within an all-encompassing system of prices, which has almost the characteristics of an organic entity, so finely articulated are the parts, so intimate the correlations within the structure of prices. It will assist in an understanding of economic processes if the nature of this system of prices and the part it plays in the working of the economic system are briefly outlined.

Economic goods, it has been explained, move from original producer to ultimate consumer down a number of parallel and connected channels, passing from the extractive stage through the hands of middlemen of various degrees and kinds and along various routes of transportation to reach the hands of the consumer at last. But movement results only when an impetus is given, when some force is in operation. What is the force which thus carries a bushel of potatoes, a ton of coal, a pound of cotton along this channel? The stimulus is the desire for profit, and the means of satisfying this desire are afforded at every step in the process of production and marketing by a suitable margin between the buying price (or cost of production) and the selling price. The satisfactory adjustment and maintenance of such price margins is essential to the functioning of the whole economic system. Goods move uninterruptedly along the channels which have been dug for them only when appropriate price differentials are maintained all along the route. Original producer, manufacturer, transportation agency, middleman—all must operate on suitable price margins if they are to perform their services. This movement of goods depends upon a satisfactory relation between prices, upon suitable conditions in the environing system of prices. Temporarily, goods may move without a satisfactory differential. The farmer may let his wheat go below cost, the miller may sell at a loss, but no permanent flow is possible under these conditions.

The mere existence of a margin between buying and selling prices is not enough; the margin must be properly adjusted. If it is too narrow at any stage goods will accumulate, and something akin to a log jam will result—a situation not uncommon during certain phases of the business cycle. Too wide a margin, on the other hand, may reduce consumer buying or may interfere with the marketing process by inviting price-cutting on the part of certain distributors. The smooth, normal flow of the great rivers of economic goods produced annually is therefore dependent upon the existence of proper conditions within the price system; upon suitable relations between the parts of that system.

Importance of Price Differentials

The existence of appropriate price differentials is important in even a wider sense than that suggested above. The primary motive to business activity under modern conditions is the expectation of profit. The business man buys and sells, organizes and administers, because thereby he hopes to make profits—pecuniary profits. The importance of the rôle played by business enterprise has been indicated in an earlier article. It is the organizing, directing, initiating fac-

[1] See MANAGEMENT AND ADMINISTRATION for February, 1924, p 215.

tor in economic life today. The economic system, as we know it, would not function without suitable profit margins which will induce such activity. This is not to say that some other system might not work; other arrangements, perhaps more equitable and more in accord with ethical standards, are conceivable. But our present economic system operates efficiently only under the stimulus of profits. When price relations permit suitable profits to be reaped, goods move, houses are built, employment is steady. Abnormally large differentials may impair the working of the system, just as too narrow margins may check business enterprise and cause stagnation. The conduct of the whole system, the proper functioning of every part of the immense structure which has been built up for meeting economic needs, depends upon the existence of suitable profit margins, and these depend upon price relations. The production and movement of goods, the employment of labor and capital, the full use of natural resources—all are conditioned by price relations.

The Price System and the Co-ordination of Economic Activities

The final significant service which the price system performs, a service not distinct from those already mentioned, but including them all, is that of serving as a medium through which order and co-operation are introduced into the economic system. The nature of this service requires some explanation.

Minute division of labor in a manufacturing or mercantile establishment increases the difficulties of administration. It becomes harder to secure the co-ordination of specialized activities of the different workers which is essential to productive efficiency. Similarly, in an economic system characterized by the high degree of industrial and geographical division of labor which is so marked a feature of the existing order, the perfection of co-ordination is vital. Consider the situation of New York City, an agglomeration of almost six million persons, engaged in highly specialized activities. It is essential to the very existence of this mass of people that supplies of meat, milk, cereals, vegetables, fruits, coal, be brought to the city in the proper quantities at the proper times. There is no one human brain which directs and apportions the flow of goods into the city. Similarly, over the whole globe, goods are moving back and forth in mighty volume between the specialized centers of human activity, and if the flow be jammed, or if there be an imperfect adjustment in time or in quantity, unemployment, suffering, perhaps starvation, result. Seldom do such maladjustments occur. The precision and timeliness with which these diverse movements are adjusted is a marvelous thing, when one considers that there is no directing hand to follow the multitude of trains and ships and to adjust their movements to the needs of the peoples of the world.

Competition as a Regulating Factor

The regulating factor is, of course, competition, working through the medium of prices. The price mechanism reacts immediately to a shortage or surplus of goods anywhere on the occupied globe; exceptionally high or low prices stimulate or retard the flow of goods, correcting at once the conditions which gave rise to abnormal prices. Not only is the flow of goods so regulated, but an efficient distribution of economic labor is secured in the same way, through the reactions of the price system to maladjustments of supply or changes in demand. It is the system of prices, encompassing the structure of organized and specialized industry, through which this regulating agent functions.

Yet, effective as this regulating agent is, it is by no means perfect in its operation. A few generations ago economists were wont to deify unrestricted competition and the freedom of enterprise which went with it, but a fuller experience with competition under modern conditions has demonstrated that there are serious dangers attached to its unrestricted operation. Some of these dangers have been suggested in preceding articles. Moreover, the price system through which modern competition operates, and which serves as the regulating medium in economic life, is itself subject to disturbances which may seriously impair its usefulness. When the price system is out of adjustment it no longer serves as a medium which reflects the economic needs of the people everywhere, and as a result delicate economic relations are disturbed and the free flow of goods and services is prevented.

The disturbances which thus affect the price system have a very important bearing upon practical business problems. Some of the effects of such price changes have been indicated. These may be summarized and certain general causes suggested.

Effects of Price Disturbances

In a profit-seeking world price differentials furnish the incentive to the activities which keep goods moving from producer to consumer. It is by no means desirable that these margins be fixed, of course. An increase in demand for a particular type of goods stimulates the flow by increasing the margin, and a falling off in demand has the reverse effect through effecting a decline in the margin. Flexibility is essential to the functioning of an economic system which meets the needs of a growing and changing society, and flexibility would be impossible with constant price relations. Such changes as we have in mind here are localized, marking a transfer of demand from one article to another. A prompt reaction of prices to these changes is highly desirable. But when price differentials are increased or decreased generally, or for large commodity groups, without corresponding changes elsewhere in the economic system, that is, when the underlying reason is not a transfer of consumer demand, serious trouble may result. Increased differentials may speed up production and distribution beyond consumers' needs, and decreased margins may have the reverse effect, impeding the proper flow of goods. Either result may cause economic trouble.

Similarly, general price changes may unduly expand or abnormally contract the profit margins which play such an important part in the operation of every part of the economic system. Large margins tend to cause the feverish activity and unhealthy expansion which

bring about a crisis, and insufficient profit margins constitute a brake to necessary business activity.

Again, general price changes seriously disturb the process by which the joint product of the agents of production is apportioned among these factors. Rising prices may swell the share of the business leader at the expense of labor or of the lender of capital, and falling prices may reverse the process. For changes in the monetary rewards secured by certain of the factors of production always lag behind commodity price changes, and thus the real income, in terms of bushels of potatoes and suits of clothes, which a given money income represents, may be seriously altered by a price change.

The irregularity of price changes may also work hardships on specialized classes of producers or specific industries. When a general rise or a general fall of prices is under way, the movement is seldom uniform in all lines. Thus laborers, business leaders, capitalists, and landowners, whose interests lie in certain industrial fields, may suffer alike, while other industries are reaping the rewards of a propitious price turn. Where such inequalities represent fundamental economic alterations, as the dying out of an old industry, such suffering is unavoidable, but when it is due to the irregularities of a price revolution it is economically wasteful.

Connection Between Industrial and Price Systems

This brief exposition is not presented as a complete account of how changes in the price system may affect the operation of industry and business. It will have served its purpose, however, if it has shown how intimate and vital is the connection between the *industrial system*, which is primarily concerned with *goods*, and the environing *price system*. The former is controlled and regulated at every turn through the latter; the disturbances which affect the latter react immediately upon the former. A sound and well-controlled price system is essential to the healthy functioning of the industrial system, and such a price system has not yet been secured.

It is beyond the scope of these articles to consider in detail the causes of the general price changes which often affect industry so disastrously. In fact, there is no general agreement among economists as to precisely how these changes are brought about. But there are certain general relations which are important in connection with these changes, and a brief explanation of these relations will make clear certain of the factors in the problem.

Factors Affecting the Price Level

A general change in prices is, of course, to be distinguished from changes in the prices of a number of individual commodities. Individual commodity prices are constantly changing as conditions of supply and demand in specific lines are altered. Such movements are essential to the normal working of a dynamic economic system. When the price level is constant such individual changes are counterbalanced by contrary movements in the prices of other commodities. But a change in the general level of prices takes place when the movements of individual prices in one direction exceed the movements in the other direction. Thus 60 per cent of all price transactions in one month may be at higher levels than the corresponding transactions during the preceding month, while 40 per cent may be at lower prices. The general level of all prices would be higher in the second month. The price level is, therefore, to be conceived of as an *average*. Prices are moving in diverse directions at any time. When upward and downward movements cancel each other, the price level is stationary. When out of the multitude of price changes more are in one direction than in the other, the price level is rising or falling. What conditions attend such a rise or fall in the level of general prices?

Since a price is merely a statement of the value of any goods in terms of money, it is obvious that any single price depends upon the quantitative relation between goods offered for sale and money offered for goods. There are, of course, conditions lying back of these two factors which must be taken account of in any study of a given problem of price determination, but in the actual settlement of a market price the complex of forces affecting demand and supply express themselves in money offered for goods and goods offered for money. In the same way the relation between the total goods offered for sale over a given period and the total of money (in any form) offered for goods, must determine the ratio at which goods and money change hands. When total goods and total money are in the balance the ratio is an average of prices or what is termed the *price level*.

Relation Between Quantity of Goods and Quantity of Money

The price level, then, depends upon the relation between quantity of goods and quantity of money. (The term money in this sense must be understood to include purchasing power in the form of commercial or bank credit, as well as the ordinary forms of metallic and paper money). When the situation over a period of time is taken into account, as it must be in studying changes in the price level, it will be recognized that the amount of money offered for goods depends not alone on the absolute amount in existence, but on the rapidity of its circulation. The efficacy for trade purposes of a given sum of money over a period of twelve months would be doubled if its velocity of circulation were doubled. If we let M represent quantity of money, V the velocity of circulation of money, M' quantity of credit, V' velocity of circulation of credit, T the volume of goods and services entering into exchange (the trade factor) and P the average price at which these goods and services change hands (the price level), the relations outlined are described by the following equation:

$$MV + M'V' = PT$$

A study of the relations between the factors represented in this equation will make clear the conditions which enter into a price movement. An increase in any of the factors on the left-hand side of the equation will serve to raise prices, provided the volume of trade re-

mains constant, while a decrease will have the reverse effect. The thoroughgoing believer in the so-called *quantity theory* of money (strictly, a quantity theory of *prices*) explains all price movements as the result of changes in some one of the other five factors in this equation. Prices are looked upon as the passive element, following movements in the other factors. Thus the tremendous rise in prices here and abroad during the war is looked upon as the result of increases in the volume of money and credit. The floods of irredeemable paper money abroad, the tremendous expansion of credit attendant upon the development of the federal reserve system, facilitated by the great increase in gold holdings in this country—these are held to be the direct and active factors in the price revolution. Opponents of the theory contend that prices themselves may play an active part—that a rise in prices may call more purchasing power into existence. Thus a merchant may be handling a given volume of trade with an average bank credit of $10,000. If prices double he may need a credit of $20,000 in order to handle the same physical volume of trade. The rise in price called new deposit credits into being.

The elements in the equation are so difficult of actual measurement that the controversy has not been settled. That there is a close relationship between quantity of money and quantity of goods is obvious, however. Whether an increase in the money factor causes or merely facilitates a rise in prices need not concern us here. It is sufficient for our present purpose to recognize the connection between these two factors. A key to the problem of price changes is furnished and methods of controlling the general level of prices are indicated by this theory.

The Control of Price Movements

The violent price changes of the last 10 years have so dislocated internal and foreign trade relations, and have at times so upset that equilibrium which is essential to business stability, that the problem of preventing such violent fluctuations has come to the fore in economic discussion. Those with the most definite views as to method are the out-and-out quantity theorists, notably Irving Fisher. The essence of Fisher's plan lies in the proposal for a compensated dollar which is designed to replace the present dollar, of fixed gold content and varying purchasing power, with a dollar of a varying gold content and, it is hoped, a constant purchasing power. These changes in the gold content of the monetary unit are to offset the effect of price fluctuations upon purchasing power, and are expected to check any but minor changes in the general level of prices. Other plans to the same end have been proposed. Of some current interest is the suggestion that the Federal Reserve Board so manipulate the credit resources of the country as to prevent marked price changes. The Federal Reserve Board itself has refused to use its power to any such end.

While none of these proposals may ever be carried out in practice they are significant as attempts to extend man's control to a field which has largely been undirected and unregulated in the past. The individual industrial unit has been studied in detail, and comprehensive programs looking toward more scientific administration have been carried out. But the system of prices which binds these units together, which furnishes the medium through which economic forces act, has come to occupy its dominating position almost without man being conscious of its development.

Business Policies and Price Movements

While these major swings of prices are not yet subject to control it is possible to frame business policies with due regard to current price movements. The importance of these fluctuations to the individual business man need not be emphasized. The memories of what happened to high-priced inventories in 1920 are still fresh in the minds of business men, to recall merely one example of how price movements strike to the heart of the individual business. These movements are not mere economic abstractions, of only academic interest, but facts of vital concern to all who buy and sell. The highest degree of internal efficiency will not guarantee business success, unless business policies be framed with the closest regard to external developments, particularly in the field of prices. To enable these movements to be followed, index numbers of prices are currently compiled and published by various agencies, and some familiarity with these index numbers is essential to effective business administration.

Index Numbers

A completely accurate measure of price movements would include all price transactions during a given period, all sales at wholesale and retail, all wage payments and payments for other services, all transactions in which the monetary factor appears. Such a measure, of course, cannot be compiled. Here, as in many other fields, we must be content with the study of a sample, and all index numbers of prices are thus based upon samples.

The three chief American index numbers of wholesale prices, those of the United States Bureau of Labor Statistics, Bradstreet's and Dun's, are alike in certain respects, though there are rather important differences. Bradstreet's, the simplest in construction, is merely the aggregate of the prices per pound of 96 commodities. Since many of these articles are not quoted on the "per pound" base, this involves a reduction of the original quotations to this base. A change in the price level is indicated by a change in the total cost of these 96 articles. These totals may be reduced to percentages, using any desired month or year as the base of these calculations. Dun's index is of the same general type, an aggregate of actual prices, differing from Bradstreet's in that more commodities are included in the sample and in that the prices of these commodities are *weighted* in proportion to their relative importance. The logic of this weighting process is obvious. A given change in the price of wheat, for example, is much more important than an equal change in the price of peanuts. The index of the Bureau of Labor Statistics is more comprehensive than either of the other two, being based upon 404 price quotations. This index is constructed by securing

weighted aggregate of actual prices, the aggregates being expressed as percentages of the 1913 total.

Certain Differences in the Three Indices

This very brief account does not permit a detailed discussion of certain important differences between these three index numbers. In comparing them, or in using any one of these as an index of price changes, these differences must be held in mind. The most important are due to differences in the commodities included. Thus Bradstreet's is heavily weighted with raw materials, in particular with textiles, and its movements are affected to a greater extent than the other index numbers by raw material and textile price movements. Since raw material prices are more sensitive to business changes than the prices of manufactured goods, Bradstreet's index is a fairly sensitive barometer of business conditions. Dun's index gives greater relative weight to foods. Food prices are affected by weather and crop conditions as well as by business conditions, and this index number may at times reflect changes of the former rather than of the latter type. The index of the Bureau of Labor Statistics is based upon prices at wholesale of a great variety of commodities, the various types being more adequately represented here than in the construction of either of the two index numbers discussed above. Manufactured goods bulk large in the commodities included, and, since the prices of these goods are generally more stable than those of raw materials, the index is less sensitive than is Bradstreet's, reflecting only the major movements of prices in general. It is without doubt the best general index of wholesale prices, though for certain specific purposes Bradstreet's or Dun's may be preferred.

Index numbers of retail prices and of the cost of living are also currently published, and serve as useful guides to movements in these two fields. The difficulties attendant upon the collection of data are so numerous, and there are so many technical problems connected with the weighting and averaging of the data when collected, that the degree of confidence attaching to measures of wholesale price movements cannot attach to index numbers of retail prices and of living costs.

The economic system operates through the instrumentality of prices, and its behavior cannot be understood unless the important part played by price relations in the flow of goods and in the apportionment of the product of industry be appreciated. The price system, however, does not function perfectly. Wide price fluctuations occur, and these throw the economic system out of gear, feverishly accelerate or choke the flow of goods from producer to consumer, impoverish some producers while pouring unearned gains into the laps of others, and work hardship by altering the shares in distribution. The study of these price movements has shown that there is a fundamental relation between price changes and changes in the volume of money, and this discovery has led to many proposals for the regulation of prices. While such price regulation is not probable in the immediate future, it is yet possible to avoid the worst effects of price fluctuations by studying the movements of index numbers of prices and by framing business policies in the light of the knowledge thus obtained.

(To be continued in the April issue.)

Outside Conveyor for Elevating Materials

By CHARLES W. GEIGER

THE non-uniform conditions existing among different industries and even among plants engaged in the same line of manufacturing, necessitate quite different types of materials handling equipment. Some devices can be of standard design, others must be special. Certain installations are made up of stationary apparatus while many will have to move or be portable.

Fig. 1 shows a piece of equipment of a special class and semiportable, that is, it can be moved and adjusted as required. It is installed in a western cannery and is used to elevate bags of sugar. Freight cars are run alongside the building and the bags are unloaded and delivered to the third floor by means of a conveyor.

As the apparatus must serve the car at a range of levels within the height of a box car, it must be adjustable within these limits. A hoist attached to the stirrup holding the lower end of the elevator accomplishes this purpose. The hoist is suspended from an overhead support and is operated by the men who are unloading the car.

Index Number
658.281 Mechanical conveyors

The economy of this installation over hand methods, a hoist, or a freight elevator is evident even without cost figures.

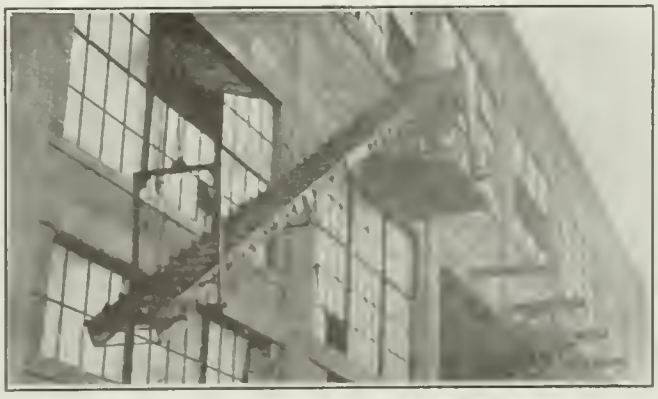


FIG. 1 CONVEYOR TO CARRY BAGS OF SUGAR

THE EDITORS' PAGE

In the Interest of Peace

AT the present time there is a real danger to the world of a war of destruction "on a super-cyclonic scale"—a war in which civilization itself is likely to be destroyed—in which all that we have made boast of in moral, material, and intellectual progress, will take its place with the "glory that was Greece and the grandeur that was Rome". It is hard to conceive of such a thing. Those who are in a position to see the future most clearly, say it is a real possibility. As stated by Lloyd George on his recent visit, unless saved by some unknowable happening, "Civilization is doomed within this generation to a catastrophe such as the world has never seen".

Nor are there lacking significant occurrences to give color to this dire prediction. The next war, if it comes, will be an aerial warfare. French air power has already increased enormously—to a point which has caused her neighbors grave concern. Signor Mussolini says: "If others arm in the air Italy must also arm in the air. The other day 300 aeroplanes flew over Rome without mishap. Next year their number will be three times that figure." Great Britain, uneasy over the overwhelming superiority of the French aerial forces, has entered on a policy of aerial expansion—to be continued until her aerial equipment equals that of any other power. France at once votes huge appropriations to maintain her supremacy. All in all, it is the vicious circle of preparedness that in itself breeds war.

As to the nature of that next war—if it is allowed to come—we are told by those best informed that it will make the last war seem but little more than child's play; that it will spare neither young nor old, soldier nor civilian, man nor woman. Aeroplanes and gas are the terms of its expression and of this gas, Philip Gibbs says in a recent article:

> That gas used in the last war was like a lady's perfume compared with the poison that has been prepared for the next war. It is a fine powder that spreads imperceptibly over a wide area, blasting all life upon which it falls. There is no gas mask yet invented through which it does not penetrate. It becomes a sluggish vapor, creeping down into cellars and underground places, lying there ready to choke any living being who comes within its reach.

It is regrettable, but it is true, that bitter partisanship has prevented the United States from leading the world in some concerted effort to make another war impossible. Since this is the case, we should do what we can to preserve world peace and at the same time place ourselves in a position to protect our own people.

The leading article in the present number of MANAGEMENT AND ADMINISTRATION, by Dwight F. Davis, Assistant Secretary of War, gives needed assurance that our War Department has a realizing sense of the present critical European conditions and, by a rarely intelligent move for preparedness, is both helping to preserve the peace of the world and to defend our people in case of need.

The last war demonstrated conclusively that the heart of a nation's military strength is not in its army, nor in its navy, nor even in its aerial forces. These must, of course, exist, if any real defense or offense is to be made, but the effectiveness of the actual fighting forces depends upon the food reserves, and the producing activities far behind the lines where men, women, and children may work to supply those engaged in actual combat with the prodigious means required for its maintenance.

It is here that our major preparation is to be made. Industry is not to be diverted from its normal course, so long as peace prevails, but is to be surveyed, and the possibilities of each important plant so charted and co-ordinated and secured, that should the need arise, the entire industrial power of the country can be mobilized almost overnight in the service of the government. A better or less harmful form of preparedness could hardly be devised. It can be used if needed, but is not "rusting out" if it is not used. When needed it is ready, but meanwhile it is not in such shape as to be a temptation to hasty, ill-considered, or unnecessary warfare.

If Germany had known that the United States would be drawn into the struggle, and more particularly, that she could and would mobilize with sufficient promptness for really effective participation, it is not probable that the Great War with its appalling losses would ever have occurred. It is not possible for European nations to engage in another mighty life and death struggle without such damage to our interests and such international complications as will inevitably draw us into the conflict. The knowledge that this is so, and that if the United States is drawn in, that the entire military and economic forces of the mightiest power on the globe will be promptly mobilized and hurled against the offending power, will surely give pause to any nation before it initiates Armageddon. It may in itself be enough to prevent the conflict that the statesmen of the world now fear.

The Biography of Frederick W. Taylor

COPLEY'S life of the "Father of Scientific Management" has been in preparation almost from the time of Frederick W. Taylor's death in 1915, a period of nearly 9 years. It is now in our hands as one of the vital books of the immediate present.

The author set out to write the biography of a great man. This he has done and done well, but he has also done much more. He has answered for us affirmatively, the question—Was Taylor, the man, as great as his work?

Further, the book is the story of the origin, development, and nature of scientific management and the Taylor System, and incidentally a portrayal and in-

terpretation of an upheaving American industrial epoch, 1880-1895.

As an intensely human story of life in industry it will be read and reread, as an exposition of management in its historical setting it will be referred to and used again and again. Nothing but good can be said of the general treatment adopted by the author. Candor and impartiality are prominent characteristics, for both the weakness and strength of the man are portrayed. The selection and grouping of material have produced an interesting narrative. This has been possible for the subject was a man who was earnest, vehement, and combative, who lived amid struggles and controversies, many with dramatic settings equal to the plots of virile fiction. The gift of interpretation has been freely used. Not only are events narrated but their meaning and significance are inquired into. All in all it is an outstanding example of research and authorship.

Because of the immensity of the task of reviewing the life of a man who did a prodigious amount of work, it is not surprising that some few incidents and statements seem out of proportion or even presented in an erroneous setting. It may even be felt that they throw the real excellence of the biography into higher relief.

Emphasis is placed upon Taylor's willingness to undertake difficult, distasteful work—the cleaning out of a stopped-up drain being particularly cited. In this respect he was no different than hundreds of engineers in charge of maintenance, who accept such jobs as part of their regular duties and perform them without any thought that they are worthy of special mention.

On page 23 of Volume II, in describing Gantt's joining Taylor at Bethlehem, the author attempts to sum up Gantt's characteristics by comparing them with Taylor's. Many who knew Gantt well will not accept the picture thus written, particularly these lines:

"Taylor was thoroughgoing; Gantt did not wish to go any farther than you were willing to have him. Taylor was profound, revolutionary; Gantt adaptable, opportunist."

The ideas that Gantt was not thoroughgoing, that he was an opportunist, will never be believed by those who knew him well. No one more clearly saw, carefully formulated, and tenaciously held to principle.

The author has seen fit to devote a chapter to Taylor's relations with the Meetings Committee of the American Society of Mechanical Engineers over his paper on, "The Principles of Scientific Management". It is regrettable that he does not tell the whole story nor give the sequel. The situation created in the Society by the withdrawal of that paper led directly to the report on "The Present State of the Art of Industrial Management" of 1912, which Taylor warmly praised when it was presented and discussed.

A minor but rather curious omission is the date of his death from the last chapter, "The End of the Pilgrimage". More than an offset to such a detail, however, is the carefully planned and worked-out index —a striking and pleasing exception to those usually found in biographies.

But, to turn again to the work as a whole:

As the last word is read and the book closed possibly the most lasting impression is that of the stupendous task attacked by Frederick W. Taylor. In magnitude and complexity the organization and management of industry can only be likened to the organization and administration of government. The latter has had centuries of development and improvement; Taylor elevated the former to a science in the brief space of 30 years.

Professional Advertising

"ETHICS of Advertising for Accountants" which appears on page 345 of this issue is a strong argument for the *proper* kind of advertising by accountants. Mr. Scovell has stated the case so clearly from his point of view that nothing need be added.

But a further word may be written from the point of view of the business man, the client of the professional man. When the business man needs professional counsel his interests and those of his adviser are served by bringing them together. An unexcelled means to that end is publicity, which can take many forms of which advertising is but one. Therefore, advertising of itself can hurt neither and may substantially aid both, for the business man is entitled to know what professional services he can secure and who can render them.

In some respects the accountant is not so well situated to make professional contracts as certain others. The doctor hangs out his sign on some principal street and has put up a continuing advertisement, which he supplements by joining the board of his local hospital, and his local medical society. The lawyer likewise hangs out his "shingle" and professionally enters the life of his community. To a much less degree can such steps be taken by an accountant.

Furthermore the public holds no prejudice against the accountant who advertises, such as is felt toward the advertising physician. And many accountants who are known to be reputable and are regularly retained by leading industrial firms have advertised.

On the other hand, accountants' advertising, as in the case of any other professional advertising, is liable to go astray unless there are some recognized limits. Perhaps a suggestion may be taken from other professions less closely hedged by ethical considerations than lawyers and physicians. For instance, the code of ethics of the American Society of Mechanical Engineers, an organization of 18,000 professional men, contains this proviso in regard to the advertising of a member:

> He will advertise only in a dignified manner, being careful to avoid misleading statements.

That is, there are just two things required of a member of the American Society of Mechanical Engineers when he advertises—common decency, and common honesty.

Would not these same requirements cover almost any professional advertising? Could even the physician and the lawyer go far astray in advertising if their statements were dignified and honest?

THE READERS' PAGE

Securing Additional Capital

IN the December number of MANAGEMENT AND ADMINISTRATION a correspondent asked for suggestions as to how he might raise additional capital—$50,000 for a small business which had reached the point of self-support but must be enlarged before it could be made really profitable. Several very interesting responses were printed on the Readers' Page of the February number of MANAGEMENT AND ADMINISTRATION. Additional letters are given below:

Editors of MANAGEMENT AND ADMINISTRATION:

In reply to the question in the December issue of MANAGEMENT AND ADMINISTRATION regarding the securing of additional capital, the writer without knowing the line of manufacture, submits the following answer, basing it only on general experience.

It would appear that the manufacturer's troubles are purely internal. A general manufacturing business with a turnover of $200,000 per year should show a reasonable amount of profit after deducting all expenses.

However, if this is not the case, but the net profit per unit is reasonable, the trouble must be that the cost records are inadequate or salaries and operating expenses are too high, or possibly the fixed charges and reserves have not been correctly analyzed.

It is fairly safe to assume that if the company carefully looked into these problems additional capital would not be the solution, as the ratio between expenses and profits would remain comparatively the same.

If there is a keen competitive market for the company's output, which would have a tendency to reduce the net profit, the only way out of this difficulty would be to reduce operating expenses through close analysis of these expenses or up-to-date methods of production.

A greater volume of production would possibly raise the net profit at the end of the year. This net profit would, however, depend upon the market conditions, whereas if each unit shows a comfortable profit and production runs along normally, there should be a substantial gain to the Surplus account at the end of the year.

Of course it is understood that the above is not necessarily the solution, the writer not knowing local conditions or the product. If, however, the business shows no profit now, surely increasing capital will not prove a panacea.

FRED A. SHARP.
Cost and General Accountant.

Editors of MANAGEMENT AND ADMINISTRATION:

In response to the inquiry of your correspondent who asks for suggestions as to how to raise a small amount of additional capital, I wish to present a plan which may meet the situation. This is the sale of stock to his own employees. In addition to procuring the capital needed, this plan serves to retain the employees in the service of the company because it increases their interest in the company.

As a rule employees should not be encouraged to buy anything but an investment interest in the business. That is, the company should sell them preferred stock rather than common stock. Probably in this case the issue would be $50,000 of preferred stock. The details of this issue should be carefully planned and cautiously handled.

There are three concessions commonly made to employees purchasing stock of their own company which should be considered. These are,

1. Permission to purchase stock at less than market value.
2. Payment to be made on the instalment plan.
3. Payment made by deduction from salaries and wages in monthly or weekly instalments.

If this company employs 500 men, and each one subscribes for a share of stock at $100 par value, the additional capital needed would be at once secured. Furthermore, additional working capital can be secured at any time in the future by a subsequent issue and sale of stock.

Very truly yours,

JULIUS E. RHODES.

Editors of MANAGEMENT AND ADMINISTRATION:

In the letters to the editors in the December number of your magazine I notice the interesting problem of the manufacturer who wishes to extend his business.

Judging by the one size factor indicated, this is a concern employing in the neighborhood of 50 people. The opportunity for saving on labor may therefore be somewhat limited, but it does not follow that enough could not be saved to allow for gradual expansion.

In the statements relative to borrowing further capital, there seems to me to be some inconsistencies. Possibly there are bank loans, in which case the equipment cannot truly be considered unencumbered; the bank would probably reduce the line of credit if money is borrowed on the equipment. There is also mention of reserves being set aside; if these are actually put into a fund which will not be used for some time, it might be feasible to borrow from that. There are also other available sources if it really is necessary to bring in cash.

In order to make more definite suggestions it would be necessary to have detailed information as to the conditions.

Sincerely yours,

H. P. LOSELY.

THE writer of the letter given below sends it in with the following statement and stipulation: "I am sending it to you, with the proviso that if you publish it you do not put my name anywhere near or around it. Confession is good for the soul but not for publication."

Editors of MANAGEMENT AND ADMINISTRATION:

I see that one of your correspondents has the same desire to raise more capital or put out a bond issue that has struck most of us at one time or another. The answer is simple—there is no legitimate way for him to get the money. He can finance it through friends, only there is the danger that "Friends" who advance money sometimes think they have bought the lender, his business, and all his future prospects.

Then there are banks, but national banks or trust companies are supposed to keep their capital liquid. He can borrow for 90 days at a time on his character, if his business looks sound, but if he renews these 90-day notes more than a couple of times the bank examiner is likely to suggest that the bank thaw out the account. Savings banks can lend on real estate, but probably that is not enough for his purposes. Then he can go to his large customers, but this is the same thing as going to friends. He does not merely borrow, he sells out and pays interest at the same time. The people from whom he buys may finance him on a basis of ultimately getting it all. There may be instances where some ultra-altruistic person has let the borrower get away with his hide, but they have escaped my notice for some years.

There is really only one way for a small business to grow and that is by financing itself. The owner has to live on salt pork and onions until his health is ruined and then there is a pretty good chance that he may make as much out of the business as he would have made by making these same savings and depositing them in the bank each week.

This sounds pessimistic. It is pessimistic. I have tried all these ways of financing a small business. At 33 years of age I was an old man. I juggled a hundred thousand in notes and a similar amount in real estate mortgages for several years. I ruined my digestion. Then the banks consolidated and they hung my pelt on the barn door to dry.

Never again will I try to finance a small business. Either let it grow naturally or else make a ten million dollar thing of it and go it for a grand success—or smash.

The Ethics of Advertising for Accountants

Editors of MANAGEMENT AND ADMINISTRATION:

Your understanding is correct, as expressed in your letter of September 25, that I am "one of those who believe that there is nothing unethical in proper advertising of professional accountants". I am indeed glad to respond to your request to open this topic for discussion, particularly as you say that my communication may be "pungent in flavor if I wish," because I do not feel that I can do justice to this topic without some use of the first personal pronoun and some other references and allusions which may seem quite pointed to some of your readers.

I am grateful to you for narrowing the discussion to "*proper* advertising of professional accountants". I will say at the outset, that I think some advertising that has been done is distinctly improper and, therefore, unethical, and some of it would have been just as unethical for a self-respecting merchant.

I also appreciate your limitation of the discussion to "professional *accountants*," because, while there may be some question regarding advertising by other professional men, the fact is that the accountants, just at the moment, seem to stand midway between those professions, like law and medicine, which are bound hard and fast by tradition and precedent, and some newer professions like engineering, which are freely, and, in my opinion, most advantageously using good advertising. I should like to throw my influence to keep the vocation of professional accountancy in harmony with the best thought of the modern business world, which accountancy has to serve, rather than see it unreasonably follow the traditions established for law and medicine.

Accountancy, Law, and Medicine

In the first place, the analogy between accountancy on the one hand, and law and medicine on the other, is extremely slight. All three, it is true, require a good education, but that is no more than can be said of many non-professional positions in the modern business world. Accountants probably deserve a standing as professionals by the conventional test of learning and skill, but medicine very largely, and law to some extent, still preserve the traditions of serving apart from a money recompense, and in all the comment about accountancy being a profession like law or medicine, I never heard anybody bring that forward as a reason for lining the three up together.

Furthermore the relation of accountants to their clients, and to the business world, is entirely different from that of attorneys. Mr. A, dealing with Mr. X, is only slightly concerned as to the name of Mr. X.'s *lawyer*. A expects X's lawyer to take sides; he is an advocate devoted to his client's interest, so long as he is a client, above all other considerations. Devotion is not a product which can be advertised.

The *accountant* who serves Mr. X may, on the other hand, have a very large duty and responsibility to Mr. A. It is one of the attractions of accountancy and, in my opinion, the best tradition of the profession, that it has a duty to the truth above all things else. Accountants must develop and support by consistent practice a reputable name, and the worth and standing of that name *may well be kept before the public*, in the interest not only of the accountants, but also of the clients who expect the firm name of their accountants to mean something to those with whom they have financial dealings.

There is another important difference between accountancy on the one hand, and law and medicine on the other, namely that there is nothing as yet to prevent any person, regardless of his qualifications or

lack of qualifications, from practicing as an accountant, and holding himself out to the world as such; whereas such a proceeding would be a violation of law for unqualified doctors, and a man would not be allowed to practice before any court unless he was a member of the bar. These restraints in respect to both law and medicine necessarily have a decided influence on the ethics of these professions, in regard to various matters, including advertising, for which there is no parallel in accountancy.

Accountants' Advertising

It is, in my opinion, a great misfortune for accountancy and accountants that the American Institute of Accountants has seen fit to take the stand it has regarding advertising, that is, prohibiting by a so-called rule of conduct, what in fact might well be regulated, but which cannot by any possibility be stopped. Indeed, one of the greatest arguments for printer's ink advertising on the part of professional accountants is the outstanding fact that nearly every one of them is already doing all the advertising he can.

I have repeatedly heard it said by those who ought to know that when the American Institute of Accountants drafted the rule which is now in force against "advertising" by members, this rule had to be considerably emasculated before it was acceptable to some of the recognized leaders of the profession, who have for a long, long time indulged themselves in some of the most effective printed advertising (booklets and bulletins) which professional accountants could do. If this sort of printed advertising is allowed to pass as reputable, is there any sense in saying that very similar material in a slightly different form, somewhat more frankly advertising, shall be prohibited? Is not this pretty close to downright hypocrisy?

Another striking piece of evidence on this issue is provided by one of the best-known firms of public accountants in the United States, and incidentally one of undoubted high standing, whose senior partner has been heard to reproach those who would advertise in the commonly accepted sense of the word, by the statement that they were thereby "commercializing" the practice of accountancy. This same firm has some excellent connections with a strongly established business organization, and keeps those connections steadily before an interested public. This, I think, is a perfectly proper thing for them to do, but the advantage of the whole proceeding, as far as they are concerned, lies in the fact that it is good advertising, and it is, in my opinion, utterly inconsistent for these same people to reproach others for advertising in a slightly different form.

Still another accounting firm with a national reputation established a branch office in an important city, in charge, if you please, not of a seasoned, professional accountant, but of a man who was a "good fellow," widely known in the community, and a skilful business getter. Will somebody who knows, please say why, even if that is "good business," it is any more "ethical" than a straightforward use of printer's ink to tell a truthful story which may bring clients into the office?

Furthermore, in common with nearly all the ambitious lawyers and doctors, accountants are consistently advertising in all the petty, hypocritical ways which are abhorrent to people who like to work out in the open. How many men have been constant attendants at popular churches, or sought admission to and attended at popular clubs, that they might be "known among men"? How many accountants, like lawyers and doctors, have diligently cultivated their golf game that they might be acceptable partners to business magnates who might, forsooth, in the intimacy of perspiration and profanity on the golf course, take a liking to the aforesaid doctor, lawyer, or accountant, and, perchance, become his client at some later date? Let me ask the professional and business world, is it better to scramble for clients in the name of piety or exercise, with a certain inevitable mixture of hypocrisy, or to tell one's story in the accepted business way, free from methods that are in any way open to criticism?

What Accountants Have to Advertise

Abandoning all such arguments by analogy or contrast, let us come somewhat nearer to the merits of the issue, and see what it is that accountants have to advertise. It is indisputable that men of good taste do not proclaim the fact that they maintain higher standards of integrity, or technical skill, than other individuals. But when the business world is looking to an organization it is, however, justly interested in standards of personnel. Our own firm, for example, could with truth say that it has consistently set high educational standards for admission to our organization, and has urged its men to qualify for professional examinations as set by various states and by the American Institute. We know that this has had its expected result on the quality of men attracted to our organization, and we have had some entirely unsolicited but nevertheless very gratifying comments from our clients on this particular point.

Accounting firms differ widely in matters of policy as to permanency of staff, and if a firm has succeeded in maintaining its personnel with a minimum of change, and has a creditable record of long service with corresponding experience available to clients, why is not that a perfectly legitimate argument to be offered to all who are interested?

Accounting firms, furthermore, vary widely in the scope and variety of work which they undertake to do. Some accounting organizations (not including ours) undertake appraisals with their own staff, or with closely allied groups, and if they think that combination of service is significant to the business public, why is it in any way improper for them to emphasize that in their printed matter? If another firm (like our own) has experience with a great variety of work in the field of cost accounting and industrial engineering, and carries on that service in connection with a well-established auditing practice, why should any fair-minded person object to that statement being put forth in any of the conventional ways likely to make a favorable impression on the business public?

We think it significant that our firm has several well-

located offices, and feel that several of our competitors are even more fortunate in that respect, but in that connection it is difficult to see why any reasonable person should object to a discriminating statement as to what kind of service a firm is prepared to give at its several offices, if, as may well happen, certain specialized service is not equally represented in all locations. Merely the name on the door may constitute an office, as far as some firms are concerned, but the letter may kill while the spirit giveth light in matters of this kind.

Need for Accountants' Advertising

An outstanding fact of great importance, when one is considering publicity by accountants, is that the possible services of accountancy, in the broadest sense of the word, are incompletely understood by the business world. It has been the well-considered judgment of some of the foremost advertisers in the accountancy field (and many other advertisers, for that matter) that whatever was good advertising for their particular firms would, at the same time, be a very legitimate help to any competent competitor.

Accountants, like our own organization, who are trying to do what is justly called constructive work, often feel very keenly the need of bringing the business world to understand the true significance and possibilities of such service. In this connection it should be said that one of the most straight-laced members of the accountancy profession, who has emphatically and persistently opposed the advertising of auditors' services, has publicly taken his stand in favor of permitting the advertising of such constructive service. It undoubtedly makes a difference to a client, particularly an industrial client, whether he has service from an organization which is doing only conventional auditing, or from one that is actually prepared to undertake entirely different kinds of professional work. Distinctions of that kind are significant, and it seems legitimate to emphasize those distinctions to the business world.

In this matter of varied service, public accountancy in the United States is somewhat different from public accountancy in Great Britain, where the company's act *requires* audits for all corporations. Our debt to the British traditions is enormous, but we have a right to our own development, and many practicing accountants in the United States think it is a great advantage that our practice is less bound by tradition, and that it does undertake a greater variety of consulting work in a single organization. This, it seems obvious to me, is a proper subject for advertising. It is, furthermore, the very essence of proper service by accountants that they should be independent. One of the strongest arguments for advertising by those who would market their product on a national scale is that advertising, with its direct appeal to the consumer, tends to make the producer independent, and the effect should be the same for accountants.

There are various ways of getting clients—some of which I have discussed in another connection—but the point I wish to make now is that if one method leaves the accountant entirely independent, and other methods place him under obligation, by any chance, the arguments are in favor of the first. Advertising is less open to criticism on that score than some other practices said to be followed by accountants of large means.

As to advertising by accountants, it may be said, as in regard to nearly all other advertising, that it is money and effort wasted unless it is linked with quality in the product or service advertised.

It seems to me probable that there is some misunderstanding as to what advertising actually accomplishes for accountants. It was not the experience of our firm, when we were advertising considerably, that printer's ink brought us directly many engagements, and aside from special advertising that various accountants have done to fit a particular occasion, it is probably true that their use of printer's ink has served chiefly to enhance a general reputation, which has to be sustained year after year by professional work of good quality to make advertising, or even continued existence, possible.

As this whole subject of advertising of accountants and accountancy has been one of great interest to me, I have taken a good deal of pains to inquire what the most active and discriminating business men think about the subject. I cannot find that they care much, if anything, about the "professional" pretenses, but there is increased disposition, particularly on the part of well-informed and discriminating bankers, to examine rather searchingly into the *quality* of the service to the exclusion of almost every other consideration.

The bankers, particularly, recall the hesitancy which the banking fraternity exhibited, only a very few years ago, toward advertising, and admit that some of the leading banking institutions in the country have helped themselves to their very great successes by the judicious use of advertising. All this has been done while other banks have followed the ancient course. I hear no disparaging comments on one group by the other, nor do I see any reason why such comments should be passed between accountants who do or do not choose to advertise.

The business world, on the other hand, has progressively less and less sympathy with unsound competition. Men who are trying constantly to expand their business have no sympathy with arguments which they think do not sound well in the mouth of a competitor. Business men are also very chary of extravagant claims, unless, indeed, claims that seem extravagant can be fortified with indubitable evidence.

These are the tests by which representative business men meet the daily world. Broadly speaking they have no objection against any man who has something to sell, services included, telling what it is and making the best case he can for the kind of service under discussion, or for the particular detail of quality which his organization is prepared to give.

If, as I believe, this statement will be increasingly true as the years go on, the mistaken sentiment which attempts to stifle publicity of legitimate interest to the business world, will find itself overwhelmed by more modern ideas.

Sincerely yours,

CLINTON H. SCOVELL.

NEWS OF EQUIPMENT
FOR THE MANAGEMENT

This department is conducted to give the essential facts in regard to new equipment which may be used in the operation of manufacturing concerns. As the sources of the items are reputable manufacturers, MANAGEMENT AND ADMINISTRATION accepts this information as reliable.

—THE EDITORS.

A Pay-roll Recorder

Index Number
658.5311 Time recorder

AN addition to the line of recording clocks of the Cincinnati Time Recording Company is known as the 27. F. A. Series and is fully automatic in its action. It will care for any number of employees such as might be in a manufacturing department or office and will handle as many as 24 registrations per day for each employee.

A typical record card is shown in the accompanying illustration.

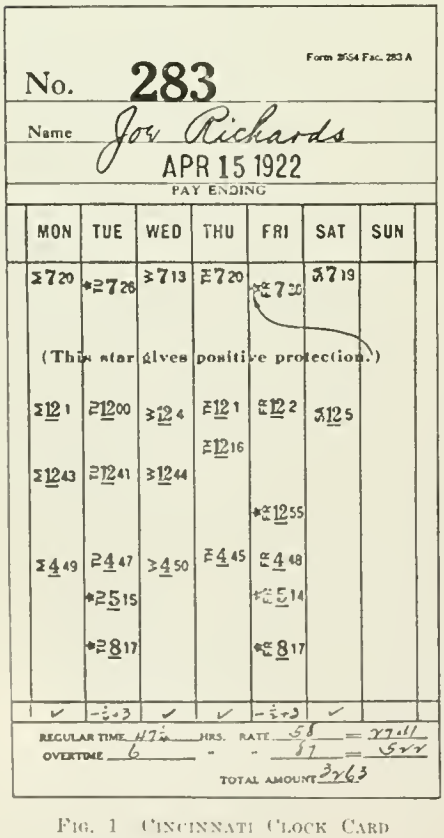

Form 2564 Fac. 283 A
No. 283
Name Jos Richards
APR 15 1922
PAY ENDING
MON TUE WED THU FRI SAT SUN
(This star gives positive protection.)
REGULAR TIME 47½ HRS. RATE .58 = 27.41
OVERTIME 6 " " .87 = 5.22
TOTAL AMOUNT 32.63

FIG. 1 CINCINNATI CLOCK CARD

The feature of the construction which permits of as many as 24 registrations per individual per day is a gradual lift cam which raises the card abutment throughout the day bringing the registrations in different spaces. Late arrivals are shown by the position of their registration in the column which is always somewhat lower on the card than the "on time" registrations.

One employee can enter the plant and record his entrance, and the next leave, and record his leaving, without any manual setting of the clock.

Turning to the illustration, it will be seen that all the registrations are made in vertical columns to facilitate figuring elapsed time.

This time recorder is made in weekly, bi-weekly, and semi-monthly models. It can be arranged to print the late arrivals, early departures, and overtimes in red. As an additional safeguard, a star is printed against the entry for late arrivals and early departures.

This clock is manufactured in both electric and spring drive and the shifts from day to day are automatic, as also the shift from the last day of one week to the first day of the following week.

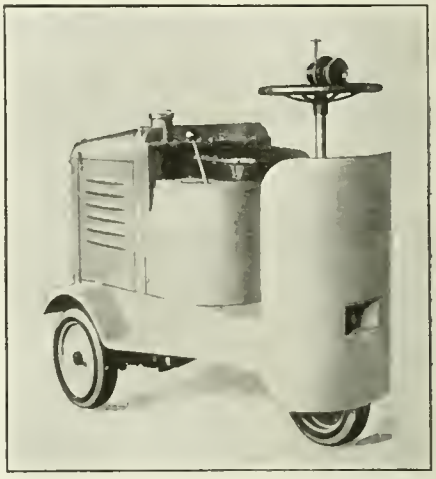


FIG. 1 "DUAT" TRUCTRACTOR

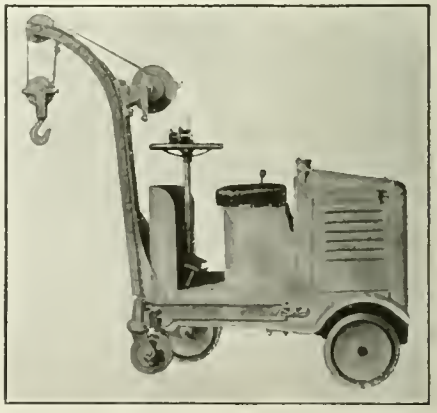


FIG. 2 "DUAT" TRUCTRACTOR WITH CRANE ATTACHMENT

Crane Truck and Tractor

Index Number
658.281 Industrial trucks

AN industrial truck and tractor known as the "Duat" has just been put on the market. It is shown in Fig. 1 in the form of a tructractor, and in Fig. 2 equipped with a crane.

In type it is three-wheel, gasoline driven. It pivots on one wheel and has a turning radius of 52 in. which means that it can be turned around in an ordinary box car. In capacity it can tow from 7 to 10 tons or haul from 1 to 20 trailers depending on the condition of the factory floor or yard. A brake beneath the driver's seat automatically stops the machine when the driver dismounts.

A one-ton crane can be provided as an attachment as shown in Fig. 2. This can be applied or removed in less than 5 min. It will lift and carry loads up to 2000 lb. The maximum height is 56 in. This machine has been particularly designed for loading and unloading box cars, lifting and towing loads through narrow factory aisles, and for inter-plant haulage.

These two machines which have been developed by the Clark Tructractor Company are intended for craning and transporting material in and about industrial plants such as machine shops, clay plants, mills,

warehouses, docks, and storage yards.

Crawler Tread Portable Loader

Index Number
658.281 Portable loader

A NEW industrial loader capable of cutting a path 20 ft. wide through a pile of material is shown in the illustration below. It is known as the "Grizzly" and has been recently put on the market by The Link-Belt Company.

The new feature of the "Grizzly" loader is the crawler tread applied to this type of equipment which is of advantage because of the frequent necessity of moving loaders over railroad tracks, rough and broken ground, piles of loose material and up inclines. Another feature is the construction of the lower base which is of solid cast steel. Upon this base is carried the loading mechanism, and it pivots on the tread in a manner similar to that employed by locomotive cranes. Tread shoes are of alloy, heat-treated steel, cast in one piece and attached in a manner which makes them practically self-cleaning.

The steering mechanism of the Crawler tread is controlled by a hand wheel. All other operations are controlled by levers conveniently located on the operator's platform on the upper swivel frame.

The loader has the ability to swivel and swing independently of the wheel or tread base. It can back into a pile of material, dig, swivel, and elevate at the same time—or it can do any one of these operations independently.

The capacity of any such equipment, of course, varies with the material handled. It is claimed, however, that the "Grizzly" will handle 45 cu. ft. of bituminous coal per min. or 40 cu. ft. of $1\frac{1}{2}$ in., or under, crushed stone per min.

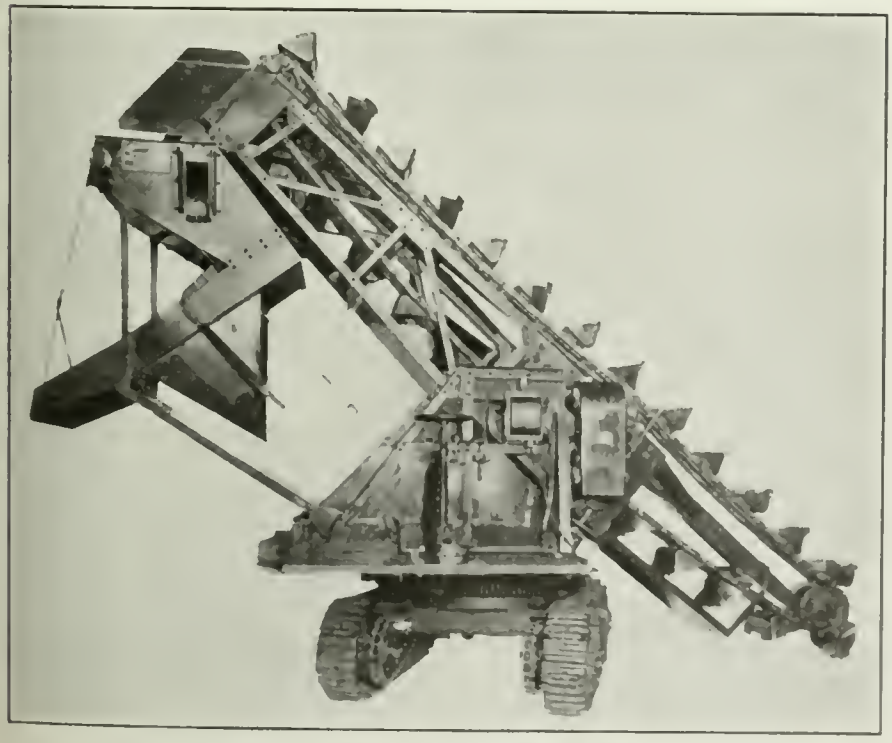


FIG. 1 CRAWLER TREAD PORTABLE LOADER

Electric-Motor-Operated Valve Control Unit

Index Number
621.846 Valve control

THE necessity for the motor operation of important valves has been fully established during the past few years, and the Cory-Reeony Electric Control Unit has been designed and put on the market with the object in view of fulfilling the many requirements involved.

The unit design makes it possible easily to mount the control on any new valve, or on a valve which is already installed. The operating controls, or stations for the control of the operating unit, can be located at a distant point; for one need only throw the switch control to the open or closed position and the control unit will automatically stop itself when the valve is full-open or closed.

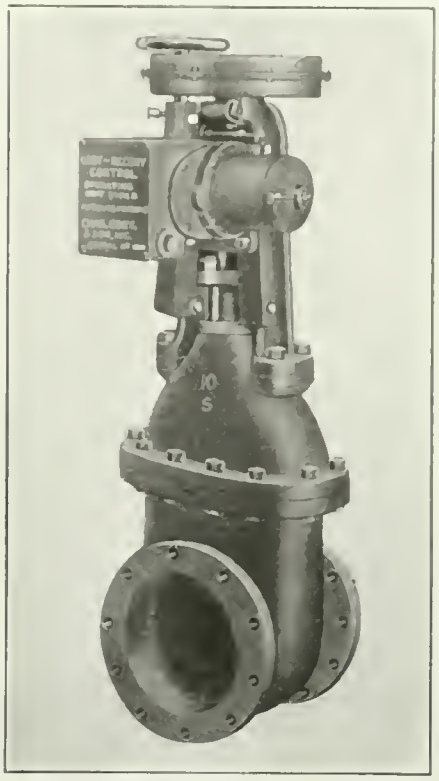


FIG. 1 MOTOR-OPERATED VALVE CONTROL UNIT

The operating unit is positive and fool-proof and there is no danger of over-travel or jamming of the valve stem. Wear in the valves can be quickly compensated for by means of simple adjustable limits built in the unit case. Adjustment of these can be made in a very few minutes.

With the Cory-Reeony Control there is no danger of mishap to an individual while making adjustments or repairs to a valve, due to some one accidently closing the distant control switch. A de-clutching lever is provided on the operating unit at the valve so that any one working on the valve can disconnect the unit both mechanically and electrically, thereby giving complete safety assurance.

Three indicating lights are provided in the distant control stations for designating when the valve

is open or closed, and also when the de-clutching lever has been set for manual operation. With this arrangement the distant operator knows at all times the position of the valve and whether the control is set for hand operation or electric operation.

Control units are made for valves operating under high and low pressure, and in sizes to fit different sizes of valves. They are manufactured by Chas. Cory & Son, Inc.

Transite Asbestos Roofing and Siding

Index Number 695.7 Asbestos roofing

A NEW corrugated roofing and siding material has recently been put on the market under the name of "Transite". It has been developed to produce a plant maintenance material as nearly immune as possible to the deteriorating effects of fire, moisture, acid, alkali, heat, or cold. It is intended to be used for skeleton frame construction.

Transite is made of asbestos rock fiber and Portland cement shaped into corrugated sheets by hydraulic pressure. A section of such a sheet is shown in Fig. 1.

These sheets are regularly furnished 42 in. wide to require fewer sheets and fewer laps in covering a given surface. This means that they can be laid over widely spaced purlins or girts. They are applied in the same general way as other corrugated sheathing.

Transite is made by Johns-Manville, Inc., for use in foundries, steel and rolling mills, warehouses, boiler-houses, engine-houses, chemical and fertilizer plants, oil refineries, heating plants, cement mills, sheds, awnings over loading platforms, and similar places where a corrugated material is applicable.

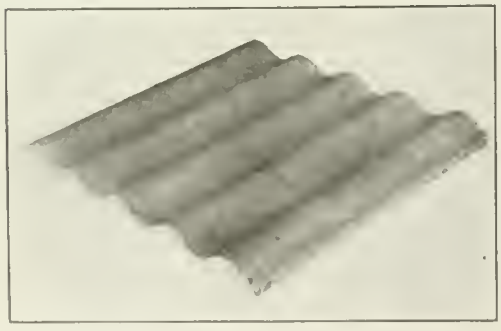


FIG. 1 SECTION OF "TRANSITE" ROOFING

A Compressed Air Separator

Index Number 621.5 Air separators

WATER is always present in air, the quantity depending upon the atmospheric conditions. A pound of air at atmospheric pressure has a volume of about 13 cu. ft., but when compressed to 100 gage has only 1/8 of this volume, or 1½ cu. ft. The smaller volume cannot hold as large a quantity of water as the original volume of free air, therefore the water is literally squeezed out of the air by the compressing process.

FIG. 1 COMPRESSED AIR SEPARATOR

The Swartwout Company has placed on the market a line of separators to remove this water from compressed air. These separators are made in both a horizontal and vertical type, the former for pipe size from 1½ to 2 in. both inclusive, the latter for pipe size from 1 to 1½ in. both inclusive.

These air separators are intended to be installed at each outlet and will deliver air sufficiently free from moisture for all practical purposes. They will also separate the lubricating oil, scale, dirt, etc., which may accumulate in the pipes.

The illustration shows two of these separators installed in the Chevrolet Motor Car Company at Buffalo on lines supplying air to wrenches and tools in the assembly department.

Long Wheel-Base Truck

Index Number 658.281 Industrial trucks

A LONG wheel-base truck has been added to the line of the Terminal Engineering Company. It will carry 5000 lb. and is intended for full load capacity of bulkier goods than could be placed on the shorter wheel base model, due to greater load carrying area.

This truck is provided with drive and handling features identical with those of the shorter model. It has four-wheel drive, each wheel being provided with a vehicle type motor enclosed in weatherproof case. Steering is accomplished with all four wheels, making possible, it is claimed, a much shorter turning radius than might be expected from a truck of this length, having a wheel base of 91 inches.

The truck is carried on four, full leaf springs and wheels with solid rubber tires 20 in. by 5 in. Brakes of the internal expanding type are ordinarily provided on two of the wheel units. The other two wheels, as all wheels are alike in general construction, may be provided with brakes if desired, although it is considered unnecessary by the manufacturer. The large wheels, individual drive, and springs are intended to permit use of the truck without construction of special runways, it being able to traverse cinder fill, snow, and ice.

The truck is designed to use separable bodies, driving under them as they stand on legs, and picking up by means of four screw jacks operated by a motor of the same frame and characteristics as those used on the wheels.

FIG. 1 LONG WHEEL-BASE TRUCK

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 150 magazines; it also includes the publications of some 50 book publishers and professional societies as far as these are of managerial interest to industrial executives. The items are prepared and classified by the Engineering Societies Library in New York City. The decimal number at the right of each item is the index number and indicates the place the article or book will take when filed in accordance therewith in the classified subject scheme. If articles are grouped according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. Photostat copies of any magazine article indexed can be supplied by The Ronald Press Company for a moderate charge. The books and pamphlets indexed can be procured from their respective publishers.

Accounting

657.524

Accounting Problems: Advanced. Charles F. Rittenhouse and Atlee L. Percy. 402 pp. McGraw-Hill Book Company, Inc.

A large number of problems in advanced accounting in the industrial, public utility and municipal fields form the subject matter of this book. While the problems themselves comprise the bulk of the work, nevertheless, each class of problem is accompanied by sufficient text to establish the principles involved. Certain topics that are not ordinarily included in works on accounting are treated. These include railways, fiduciaries, universities and municipalities. Mergers, reorganizations, holding companies, receiverships and bankruptcies are also covered, and considerable attention is given to the fundamental principles of actuarial science. To make the book more serviceable for those contemplating taking the certified public accountants' examinations, a large number of typical questions from such examinations are given. In the appendices to the book are presented a classified list of accounts for steam railroads as prescribed by the Interstate Commerce Commission, and a similar classified list for gas and electric companies, as prescribed by the Department of Public Utilities of the Commonwealth of Massachusetts.

657.42

Determination of Net Earnings Available for Bond Interest. Percy W. Brown. *Harvard Business Review*, January, 1924. v. 2, pp. 219-223. The various theories of depreciation discussed under the topics: Deduction of depreciation; What is vital to the investor? What operating expenses include; The Knoxville water case; and Deduction of federal taxes.

657.5

Getting the Most out of Business Records. M. L. Carey. National Association of Cost Accountants. *Official Publications*, January 15, 1924. v. 5, no. 9, 11 pp. Figures have to be explained, so the author advocates the use of the "picture element in the accountant's final set-up". There should be economy in compilation, simplicity in method, and an elimination of records not used.

336.24

Income Tax Procedure for 1923 Returns. By William B. Castenholz. 141 pp. La Salle Extension University.

For those who need a concise manual embodying the more important phases of income tax procedure, this book will be especially useful. By means of facsimile forms filled in, illustrative examples, and sample computations it shows the method of computing the tax accruing to many forms of business, and to individuals with wide ranges of income, subject to surtax, and allowed many different forms of deductions and credits. For example, it shows the computation of the taxable gain or deductible loss on securities purchased prior to 1913, and sold in 1923 under different conditions of profit or loss. Another example shows the advantage of husband and wife filing separate returns, even for a small total income. The book is essentially an instruction book, and the presentation of the subject matter is clear and informative, without being burdened with lengthy discussions of the law and the regulations appertaining thereto. Partnership, corporation, and fiduciary returns are all illustrated by means of worked-out examples, showing the treatment to be given to the many puzzling cases that may arise in such returns. The explanation of the inventory as used in the return for a business is excellent, as is the discussion of the general administrative features of the law.

657.524

Operating Adjustments under Standard Costs. R. W. Darnell. MANAGEMENT AND ADMINISTRATION, February, 1924. v. 7, pp. 183-186. In this, the last article of the series, Mr. Darnell discusses the perpetual inventory as an essential element of effective cost control, explaining its function, its place in the system of standard costs, and its monthly adjustment to meet the inevitable discrepancies between standard and actual costs. Adjustments for material, labor, and overhead are taken up in turn.

657.524

Our Cost-Finding Methods Keep Revealing New Savings. E. V. Connett, Jr. *Factory*, January, 1924. v. 32, pp. 42-44. What was disclosed by the installation of a cost system in a hat factory which had previously run without any accounting system. Control was made possible and bad methods were corrected through the study of costs.

657.5:629.12

A Practical Method of Cost Accounting in a Shipbuilding or Ship Repair Plant. National Association of Cost Accountants. *Official Publications*, January 2, 1924. v. 5, no. 8, 20 pp. A definite outline for compiling and keeping costs, with cuts of the forms and instruction for their use.

657.524

Supplying Financial and Cost Information. G. M. Pelton. MANAGEMENT AND ADMINISTRATION, February, 1924, v. 7, pp. 169-172. Both the accountants and executives of financial, merchandising, and operating functions of a business should fully recognize and understand the problems and services of the other. Discusses what cost items are needed, how they should be interpreted and used. Covers most factors which must be considered in financing the average business.

Building and Equipment

658.25

Modern Maintenance of Plant and Equipment. W. G. Ziegler. *Industrial Management* (N. Y.), February, 1924, v. 67, pp. 99-105. Illus. The fourth article in this series: The plant plumber, the pipe fitter and the tinsmith and what they mean to production. Emphasizes especially the importance of ventilation and heating. Heating systems, piping systems, and all their accessories are discussed. Too low or too high temperature means a direct loss in production.

658.2

The New Competition and Your Building. G. C. Nimmons. *Industrial Management* (N. Y.), January, 1924, v. 67, pp. 3-7. The first of a series of articles. Since all manufacturers are on about the same footing as regards improved machinery, they must turn to the improvement and development of the industrial building itself, as a means of increasing the volume and lowering the cost of production. Touches on factors to be considered.

658.2

The New Competition and Your Building. W. F. Ballinger. *Industrial Management* (N. Y.), February, 1924, v. 67, pp. 91-97. Illus. The real job is to select those arrangements, materials, and methods that function to increase production without increasing cost, or to decrease cost without sacrificing output. All the steps necessary when considering new building construction are outlined.

658.2

Raising Capital for That New Factory Building. Morgan G. Farrell. *Factory*, January, 1924, v. 32, pp. 36-39, 84. Illus. Various possibilities of financing plant enlargement, covering: Sale of stock, Inducements offered by organized communities, Construction mortgages, Building Loan associations, and Negotiating loans within the trade.

Buying. Shipping. Storing

658.7

Extreme Variety vs. Standardization. J. H. Van Deventer. *Industrial Management* (N. Y.), February, 1924, v. 67, pp. 81-88. Charts. Raw material ordering routine at the Schenectady plant of the General Electric Co. embraces an almost infinite variety, from microscopic X-ray parts to turbo-generator units, or from pig iron to platinum. Control system in three parts: 1. raw material; 2. work-in-process; 3. finished stock apparatus. Describes comprehensively the centralized and decentralized methods necessary and illustrates same with graphic charts and record cards.

658.78844

Fiber Shipping Case Economies. W. A. Vollmer. MANAGEMENT AND ADMINISTRATION, February, 1924. v. 7, pp. 187-193. Illus. Gives the salient feature of fiber case economies. Shows that such cases are subject to a definite amount of standardization, are easily packed, sealed, and delivered by gravity, insure safety, occupy little storage space, etc. Describes machinery for making and gives many examples of the use of such containers.

658.7

How a Buying Calendar Can Help Profits. Edward A. Filene. *System*, February, 1924. v. 45, pp. 183-187, 263. Considers, from a merchandising point of view, the significance of the following seven dates in the buying calendar: (1) First showing of high-class samples; (2) Showing of full lines; (3) Busiest season begins; (4) Busiest season ends; (5) Between season showing; (6) "Job" season begins; and (7) Season ends. Being "open to buy" in dull periods has enabled some merchants to plane down the higher peaks with a resultant gain to both manufacturer and retailer. Contains chart.

658.78

Receiving, Storing and Issuing Factory Material. P. M. Atkins. *Industrial Management* (N. Y.), February, 1924, v. 67, pp. 120-126. Charts. A guide to arrange for material control including two types of materials—that received from outside and commonly called "stores" and that made within the plant and called "worked material". Subjects under discussion are: receiving of goods and flexibility in layout necessary to provide for maximum receipts; plan layout considering weight, size, and protection of materials; and devices such as tiering machines and counting scales. Tags and record cards are described and illustrated.

658.7

The Science of Buying Material. P. M. Atkins. *Industrial Management* (N. Y.), January, 1924, v. 67, pp. 19-23. Intimate acquaintance with the needs and possibilities of his own company, familiarity with marketing principles, knowledge of vendors, ability to follow up successfully, and other necessary attributes of the competent purchasing agent. After considering the problems of the purchasing department, the author touches on methods of routine work of the department.

Economics

338

Economic Problems of Industrial Organization. F. C. Mills. MANAGEMENT AND ADMINISTRATION, February, 1924. v. 7, pp. 215-219. A consideration of the factors upon which the amount of national real income depends. These factors are: National resources, Capital equipment (and the surplus), the size of the population devoted to industrial production, the aptitude, intelligence, and training of the members of this population, and the amount and character of the organizing ability at the disposal of any economic group. The author analyzes the constituent elements of the individual business unit and indicates the part played by a specialization within the unit.

336.24

Federal Income Taxes; Principles and Practice. By E. E. Rossmoore. 864 pp. D. Appleton & Co.

The income tax amendment to the federal constitution and the laws passed to carry this amendment into effect have given rise to many problems, which have been the subject of almost numberless rulings and regulations by the Treasury Department. The present book is an unusually clear exposition of the questions that have arisen in connection with the computation and collection of income taxes. It is divided into three sections, dealing respectively with the principles of the income tax laws, with questions relating to current practice, and questions relating to earlier practice, that is, questions under the laws prior to the Revenue Act of 1921 and its later amendments. The section devoted to principles is largely an explanation in non-technical language of the various sections of the law. The practice is illustrated by 467 problems dealing with actual cases that have arisen under the law. These are handled, first, by a statement of the problem; second by a solution, showing the computation of the tax or a statement of the liability or non-liability to tax; third, by references to the section of the law or to the ruling or regulation governing the case; fourth, by a statement of the treatment of the problem under prior acts. An appendix contains the full text of the Revenue Act of 1921, as amended March 4, 1923, with marginal notes indicating the example in the book that illustrates the application of the various sections.

669.1

Has Our Industrial Capacity Been Overbuilt? A. O. Backert. *Iron Trade Review*, January 3, 1924. v. 74, pp. 3-6, 16. Charts. Statistical survey of the production of pig iron and steel since 1913. Ills of 1923 may be attributed to overproduction due to war-time expansion but a few years such as that just past will restore a state of equilibrium.

338.85

Pricing Policy in Relation to Financial Control. Donaldson Brown. MANAGEMENT AND ADMINISTRATION, February, 1924, v. 7, pp. 195-198. Outlines a method of price analysis which, though resting upon a theoretical basis, is wholly practical. General Motors' theory of pricing has this definite objective: to gain, over a protracted period of time, a margin of profit representing the highest attainable return commensurate with capital turnover and wholesome expansion, with adequate regard to the economic consequences of fluctuating volume.

669.1 :338

Steel Industry Expands on Coast. D. Partridge. *Iron Trade Review*, January 3, 1924. v. 74, pp. 40-44. Illus. Pacific coast as steel center. Inability of Eastern states to supply demand during the war created incentive to produce steel in Western States. Local market now absorbs output.

38(06)

What About Trade Associations? Edward Eyre Hunt. *American Machinist*, January 10, 1924. v. 60, pp. 41-43. Takes up the subject of the legality of collecting statistics by trade associations, and cites several court decisions which affect the status of these associations. Gives objects and purposes for maintaining the associations and says: "The assumption seems to be that the channel through which the information is obtained by association members and not the use of that information is what the Attorney General desires to regulate."

Financial Control

658.14

Applying the Budget to Industrial Operations. T. B. Fordham and E. H. Tingley. MANAGEMENT AND ADMINISTRATION, February, 1924. v. 7, pp. 205-208. Explains the method of analysis used by the comptroller and shows how the balance sheet can give past con-

ditions and furnish a forecast for the future. Tables give division budgets, number of employees estimated, estimated operations, etc., and the author demonstrates how a study of these bring about planning. The system of budget control discussed is based fundamentally upon the disposal of the product.

658.14:621.33

Electric Railway Costs Approaching Stabilized Conditions. *Electric Railway Journal*, January 5, 1924. v. 63, pp. 18-20. Gives chart and table showing the trend of wholesale prices of all commodities, construction costs, operating materials costs, wages, and fares, for the period 1914-1923. From these and from earlier economic history the conclusion is reached that by the close of 1924 the industry will be in a position to make satisfactory estimates.

658.14

Financial Investigation of Industrials. F. G. Coburn. *Harvard Business Review*, January, 1924. v. 2, pp. 154-159. Points out the kind of information needed as a basis for the correct examination of a company's business and financial policies in the past, present and future. Goes into its financial structure, credit policies, sales policies, and other features which tend to show its status.

332.6

No Par Value Stock. F. H. Hurdman. *Journal of Accountancy*, February, 1924. v. 37, pp. 91-100. Stresses the simplicity which attaches to the construction or set-up of no par stock and conveys the thought that the real difficulty, if any exists, is in preserving a definite separation between contributed capital and earned capital. Touches briefly on the situations created by the use of stock of no par value in reorganizations.

658.14

The Operating and Financial Ratios Characteristic of Industries. J. H. Bliss. MANAGEMENT AND ADMINISTRATION, February, 1924. v. 7, pp. 155-160. The viewpoint maintained in this article is that of the manufacturing and merchandising industries. Shows that there are characteristic ratios of operating results in different lines of business. Tables give statement comparing, for different industries, the value of products, cost of materials, wages, etc., characteristic margins and expense ratios in different industries, and comparison, for different industries, of the value of products and capital used. The third article in the series: "Capital Requirement and Control".

658.14

Pricing Policy in Relation to Financial Control. Donaldson Brown. MANAGEMENT AND ADMINISTRATION, February, 1924. v. 7, pp. 195-198. Outlines a method of price analysis which, though resting upon a theoretical basis, is wholly practical. General Motors' theory of pricing has this definite objective: to gain, over a protracted period of time, a margin of profit representing the highest attainable return commensurate with capital turnover and wholesome expansion with adequate regard to the economic consequences of fluctuating volume.

658.14

Supplying Financial and Cost Information. G. M. Pelton. MANAGEMENT AND ADMINISTRATION, February, 1924. v. 7, pp. 169-172. Both the accountants and executives of financial, merchandising, and operating functions of a business should fully recognize and understand the problems and services of the other. Discusses what cost items are needed, how they should be interpreted and used. Covers most factors which must be considered in financing the average business.

332.6

Van Dyke's Complete Bond Value Tables. By J. E. Van Dyke. The Financial Press.

This book comprises a complete set of tables giving value and yield of bonds at various rates of interest and for various periods. The tables cover coupon rates of 3, 3½, 3¾, 4, 4¼, 4½, 4¾, 5, 5¼, 5½, 5¾, 6, 6½, 7, 7½ and 8 per cent per annum, and yields ranging from 3 to 15 per cent, progressing by eighths, tenths and quarters from 3 per cent to 12 per cent, and by quarters from 12 per cent to 15 per cent. The values are given for half year periods from six months to 50 years, one year periods from 51 to 61 years, and five year periods from 65 to 100 years. Other tables included are tables of effective ratios for finding the values of bonds at intermediate periods between interest dates, and tables of accrued interest.

658.14

We Needed $150,000 More Capital, But ——A. E. Simmons. *System*, February, 1924. v. 45, pp. 163-166, 270. Illus. An interesting account of a plan for using employees in selling a company's stock to customers. Workers were carefully trained to do intelligent selling, prizes were offered and a quota was set for each worker. Results proved the value of the plan not only in dollars, but in gaining a closer co-operation with employees and customers.

Fuel

658.26

Combustion of Fuel. Walter C. Edge. *Universal Engineer*, January, 1924. v. 39, pp. 38-42. A detailed study of the factors which result in a maximum percentage of heat production from the fuel consumed in the boiler room. Points out the necessity for CO_2 and draft recorders, and the value of keeping records. Emphasizes the importance of obtaining the co-operation of the fireman.

662.624

Economic Phases of Coal Storage. F. G. Tryon and W. F. McKenney. *Mechanical Engineering*, February, 1924. v. 46, pp. 73-76, 108. Aims to show, first, how far the practice of storage has already been adopted; and second, to consider the inducement to storage offered by the periodic fluctuations in price and supply of coal. The author uses many figures and charts to illustrate his points.

662.76

Industrial Sales of Gas and How Increased. H. O. Loebell. *Gas Age Record*, January 12, 1924. v. 53, pp. 41-45. One of the chief drawbacks to the use of gas in industry is its present high cost. This can be remedied by the general elimination of the restrictive heating value standard requirements and the adoption of better systems of rate structure. Author emphasizes the need of the proper organization, men and personnel to carry on and promote the industrial phase of the gas industry.

662.6

Looking Ahead in Our Fuel Development. Floyd W. Parsons. *Gas Age Record*, January 26, 1924. v. 53, pp. 107-108, 126. Passing of raw coal as a fuel is in sight because of great economic loss. Present unfair situation in freight rates hampers the by-product coke industry, a business desirable to develop from the viewpoint of science, economy and public welfare.

Discussion of oil and gas as fuels of the future; oil will not be available for all industries, owing to its limited supply and its use for the world's ocean commerce; gas will be the ultimate fuel for future general use; supply plentiful and rates lower; advantageous for all industries.

662.65(0021)

Range of Coal Prices During Past Year. *Black Diamond*, January 5, 1924. v. 72, pp. 8-10. Eight graphic charts from which it is possible to determine at a glance the range of prices of any one of eight varieties of coal, on a given date in 1923.

662.76

600 Per Cent Increase in Production after Fuel Change. *Gas Age Record*, December 22, 1923. v. 52, pp. 771-72. Gas was found by the Beaver Tile Company, Cranston, R. I., to be the only satisfactory fuel for turning out a uniform product at the highest rate of speed. Describes their oven for baking cork, fitted with gas pressure burners and emphasizes the advantage of frequent inspection by the gas company engineer.

662.991

Speeding up Production by the Aid of Gas Boiler. J. E. Bullard. *Gas Age Record*, January 19, 1924. v. 53, pp 87-88. Illus. The R. I. Webb Co., Pawtucket, R. I., found drying textiles by use of gas boiler lowered cost and increased production 400 per cent. Gas boilers automatically regulated saved labor. Brief description of operation is included.

Industries. Special

658.9:665.7

Industrial Sales of Gas and How Increased. H. O. Loebell. *Gas Age Record*, January 12, 1924. v. 53, pp. 41-45. One of the chief drawbacks to the use of gas in industry is its present high cost. This can be remedied by the general elimination of the restrictive heating value standard requirements and the adoption of better systems of rate structure. Author emphasizes the need of the proper organization, men and personnel to carry on and promote the industrial phase of the gas industry.

658.9:625.2

Mass Production of Railway Wagons. *The Engineer (London)*, December 28, 1923. v. 136, pp. 697-700. A description of the series of operations in the production of wooden freight cars at the Derby works of the London, Midland and Scottish Railway. The cars go forward in an orderly manner from one stage to the next, with a minimum of material handling and a maximum output. Well illustrated.

658.9:629.113

Providing the Engineer with Service Data. O. T. Kreusser. *Society of Automotive Engineers Journal*, January, 1924. v. 14, pp. 63-67, 73. Gives suggestions for a simple chart system to be used in all automobile service stations, for keeping a record of the nature of every repair and adjustment job. These charts, consolidated in one master chart, reveal current troubles, permit an immediate check on what is happening in all sections of the country, and enable the engineer to determine what it is necessary to do in order to correct or eliminate difficulties. Sample chart given.

658.9:650.6

The Regulation and Management of Public Utilities. By Charles Stillman Morgan. 362 pp. Houghton Mifflin Co.

The general problem of the public control of business enterprise forms the subject matter of this book, although the public utility has been made the specific object of study for the purpose of elaborating the author's thesis. The author states that the principal conclusions reached through his study are that public necessity, in the case of public utilities, requires the establishment of such conditions as will conduce to the maximum utilization of the means of production, and that these conditions shall be such as to stimulate and reward management rather than capital, as such, for superior efficiency. The problem is discussed under four general heads: Efficiency in Public Utilities, which includes statistical and other evidence and factors which explain the present situation; Aspects of the Problem of Management; Methods at Present Used to Promote Efficiency in the management of Public Utilities, which covers a discussion of the sliding scale, service-at-cost plans, and other devices, regulation by commissions or other agencies, engineering, accounting and other technical assistance, valuation and rating of utilities, control of securities, regulation of service and of competition, and rewards for superior efficiency; Elements of a Constructive Program, which considers the factors of labor, changes in the public utility field, the rewards of management, the measurement of results, standards of management, and constructive work for state commissions. The appendices to the book list the states having prescribed state-wide utility standards, typical service-at-cost ordinances, etc., and a bibliography.

Management

658.16

Co-ordination of Production and Sales in a Manufacturing Business. D. W. K. Peacock. *American Management Review*, January, 1924. v. 13, pp. 3-9. An article on organization to show what certain positions mean in an organization, what are their functions, what lines of co-operation are necessary between staff officers and what authority such positions carry. The executive must co-ordinate all activities.

658

The Executive Airplane. Howard Coonley. MANAGEMENT AND ADMINISTRATION, February, 1924, v. 7, pp. 153-154. An inspirational article comparing the thrills of an air flight with the sensations a business man feels when he has a firm grip on the executive airplane. A single sheet is the panoramic view of the business—all its buying and selling, its receiving and paying.

658.1

Executive Control of Future Results. Wallace Clark. MANAGEMENT AND ADMINISTRATION, February, 1924, v. 7, pp. 179-182. A method of graphic control which brings out a conception of business as composed of moving forces, a running comparison of actual performance with what has been planned, and an understanding and control of the changing streams of work. A specific example is used to make the method clear, and charts are included.

658

Increasing Production and Reducing Costs. Guy H. Rumpf. *Society of Industrial Engineers Bulletin*, December, 1923, v. 5, pp. 4-8. An address before the S. I. E. Chicago chapter covering plant and equipment, material, men, and the other factors which effect production.

658.787

The Inventory as a Tool of Management. A. H. Rodriek. *Factory*, January, 1924. v. 32, pp. 33-34, 74. How one factory handles the pricing and other features of inventory work aside from the actual count and recording of quantities. Results give a reliable inventory valuation which is a help in preparing the company's income tax returns.

658

Management in the Public Interest. Robert T. Kent. *Iron Age*, January 17, 1924. v. 113, pp. 215, 264-265. Gives argument which the public have a right to use in insisting on the best management of its industries. Believes that costs can be kept low and prices need not be raised if the industries are properly managed.

658

Management's Responsibility to Industry. George M. Verity. *Printers' Ink*, January 10, 1924, v. 126, pp. 123-124, 128. Human progress revolves about Management, whether it is political, religious, commercial, industrial, financial or in human relations. Management must contribute to the development of a national conscience that will defend, improve and perpetuate the civilization of our time.

658

Maschinen- und Handarbeit. *Maschinenbau*, December 13, 1923. v. 3, pp. 125-126. Reports of conferences on management held in Berlin in 1923.

658

A New Year's Inventory of My Official Self. F. W. Parsons. *Gas Age Record*, January 5, 1924. v. 53, pp. 17-18, 26; and January 12, 1924, v. 53, pp. 47-48, 54.

Reflections of a gas company manager on the requirements of a successful executive. Emphasizes foresight and preparation for important industrial developments. Condemns the unjust rules and regulations that hamper officers of utilities from providing working incentives, rewarding loyalty and ability, adopting plans for employee representation, and making expenditures for any and every purpose that holds forth promise of increasing individual production, building good-will or in any way lowering costs.

658.16

The Organization of a Statistical Department. M. B. Folsom. *Harvard Business Review*, January, 1924. v. 2, pp. 179-193. An exhaustive article on the value and use of statistical information in all branches of a business. Specific examples are given of work done in this line by the Statistical Department of the Eastman Kodak Company. The Department organization chart of this company is given together with other graphic illustrations.

658.16

Profitable Methods for the Small Shop. G. C. Brown. MANAGEMENT AND ADMINISTRATION, February, 1924, v. 7, pp. 161-167. The two fields of the small factory are (1) those featuring quality rather than quantity or volume of output, and (2) those which operate to meet a local or community demand. Compares, from the organization angle, management methods of the large and small plant and shows, by means of a chart, which functions are distributed in a large organization and concentrated in a small one. This careful study will show the Executive of the small plant that management is essential and economical. To be continued.

Mathematical Calculations

510.8

Graphische Preisberechnungen. C. V. Dobbeler. *Maschinenbau*, December 13, 1923. v. 3, pp. 112-113. Illus. How graphs are used to determine prices under the present condition of constantly changing money values in Germany.

510.8

Grundlagen der Nomographie. *Maschinenbau*, December 13, 1923. v. 3, pp. 99-107. Comprehensive analysis of the principles of nomography.

510.8

Preisberechnungen bei veränderlichen Grundpreisen unter Zuhilfenahme der Rechentafel. Bernhard Stahl. *Maschinenbau*, December 13, 1923. v. 3, pp. 115-117. Illus. Describes tables used to fix prices in relation to the changing costs of raw materials.

Mechanical Handling

658.281:662.65

Coal-Storage Systems for Large Plants. *Power*, January 29, 1924. v. 59, pp. 172-173. Illus. Describes bridge tram system, cableway system, serapers to reclaim coal, and the skip hoist used in connection with the seraper.

658.281:662.65

The Locomotive Crane as a Coal-Storage Machine. *Power*, January 22, 1924. v. 59, pp. 133-134. Illus. Shows the advantages of the locomotive crane and the saving in cost if there are other uses to which the machine can be put. If the time spent in handling coal be charged against coal storing, the total average cost per ton will vary between 10 and 18 cents.

658.281

Mechanical Loaders and Unloaders. M. W. Potts. *Industrial Management* (N. Y.), February, 1924, v. 67, pp. 107-114. Illus. A very important part of mechanical handling lies outside the plant in the receipt and delivery of goods. Delays result in serious handicap to railroad management, to the public who need the cars, and there is a financial loss through the payment of demurrage. Portable bucket elevator used to unload direct from cars to trucks; small portable belt conveyors; power shovel unloading bulk material into elevators which carry it to storage bins, slate and gravity conveyors, large locomotive crane equipped with magnets, grab buckets, slings, etc., are described.

658.281

The Pneumatic Conveying of Materials. M. W. Potts. *Industrial Management* (N. Y.), January, 1924, v. 67, pp. 9-15. Considers the components of the pressure and suction types, and their operation, and gives illustrations of the application of the system in conveying coal in a large plant, in handling blue fume in a lead smelter, in unloading grain, etc.

658.281:621.72

Savings from Conveyor and Molding Equipment. R. T. Kent. MANAGEMENT AND ADMINISTRATION, February, 1924, v. 7, pp. 209-214. A practical article showing possibilities for the use of special machinery not only in the manufacturing of small or medium weight castings, but also in the foundry making larger tonnages. Describes and gives diagrams of equipment in use in up-to-date plants.

658.281:662.65

Some Methods of Storing Coal. *Power*, January 15, 1924. v. 59, pp. 96-98. Gives illustrations and description of several low-priced conveyors for handling coal in the small plant.

Mining

622.86

Mine Rescue Standards. *Colliery Guardian*, December 28, 1923. v. 26, p. 1609. A tentative study of standards prepared by a committee of the International Mine Rescue Standardization Conference held at St. Louis, Mo., September, 1921.

622(07)

Mining Education in the Yorkshire Coal Field. G. Forster. *Colliery Guardian*, December 21, 1923. v. 126, pp. 1549-51. Development of mining education in West Riding, Yorkshire since 1889. The present system of local part-time evening and technical education and University standard education are comprehensively outlined. Discussion by mining men and instructors follow.

622.233(003)

Standardization in Mines. J. H. Edwards. *Colliery Guardian*, December 28, 1923. v. 126, p. 1612. Economies realized by the Elkhorn Piney Coal Mining Co. through standardization of machinery and equipment, thus increasing efficiency and lowering operation costs. Describes system used.

Personnel

658.3816

Absentism Factors for Industrial Plants. J. D. Hackett. MANAGEMENT AND ADMINISTRATION, February, 1924, v. 7, pp. 199-203. An analysis of the whole question and suggestions for a remedy. Gives as the three principal steps in prevention (1) Centralization of prevention measures (2) Determination of character and extent of absence and (3) Establishment of method for dealing with problem. Includes statistical tables.

658.315

Building Good Employee Relations in Kansas City. *Electric Railway Journal*, January 12, 1924. v. 63, pp. 63-66. Principles underlying the cooperation between the management and employees of the Kansas City railways. Gives the organization of the employees' representation plan and of the employees' brotherhood.

658.3

Course in Personnel Administration. By Ordway Tead. 246 pp. Columbia University Press.

Originally prepared as a text-book for the home-study course in personnel administration offered by Columbia University, this syllabus with questions has a much wider field and, in connection with the collateral reading recommended, will give a broad view of the whole science to anyone interested in this subject. It includes everything that is comprised in personnel work, and even takes up some subjects that might more properly be left to the field of the engineer. The scope of the book may be judged by a few of the chapter headings. Some of these are: Organization and Function of the Personnel Department; Sources of Labor Supply; Selection of Employees; Industrial Health Work; Fatigue; Job Analysis; Production Standards; Job Specifications; Labor Turnover; Foreman Instruction; Job Instruction; Hours and Working Periods; Wages; Profit Sharing and Stock Purchase by Employees; Shop Committees; Collective Bargaining. Not the least valuable feature of the book are the appendices which occupy more than half of the pages. These mainly consist of excerpts from published articles, and illustrate the practical application of some of the principles described in the text. For instance, the discussion of the shop committee is illustrated by an article in the appendix reprinted from *The Survey*, describing the working of this device at the plant of The American Rolling Mills Company. The book should be a valuable addition to every personnel library.

658.3112

"High Cost" of Vice Presidents and Causes Thereof. John Oakwood. *Forbes*, January 19, 1924. v. 13, pp. 442-444, 467. Banks and corporations are beginning to feel the first symptoms of shortage in labor and to offer profit-sharing plans to induce men to take the big jobs. Article shows, in a popular way, how labor, through high wages, has made an appeal to clerical workers and so caused a shortage in the ranks from which executives are usually chosen.

658.3

Increased Industrial Acquaintanceship —Interview with Carl F. Dietz. *Iron Age*, January 17, 1924. v. 113, pp. 211-214. Describes plans for bringing management and associates together. Courses in economics, the Service Club. Pensions to superannuated employees. Group insurance and interest in personal investments win good-will and loyalty.

658.3115

The Industrial Psychology of Individual Differences. D. A. Laird. *Industrial Management* (N. Y.), February, 1924. v. 67, pp. 71-77. Charts. A discussion of the basic facts for selecting workers. "We have not settled the problem of individual differences in the selection of workers by merely acknowledging their presence and importance. Employment practice demands that we know in intimate detail the nature and causes

of these variations." Author is of the Yale Psychological Laboratory.

658.3855

Intra-Plant Relationship and Industrial Leadership. R. H. Booth. *Mining and Metallurgy*, February, 1924, v. 5, pp. 67-71. Illus. An explanation of the novel system of wooden blocks used by the Bridgeport Brass Company to demonstrate to their employees the fundamental workings of their business. These varicolored material symbols are used to visualize business economics, and so arouse a financial interest in their enterprise.

658.3126

Reducing the Turnover of Labor. Carbis A. Walker. *Iron Trade Review*, January 31, 1924. v. 74, pp. 350-352. Charts. Gives many helpful suggestions for reducing the percentage of labor turnover which may be summarized in these words: "When all employers recognize the importance of intelligent employment methods, the millions of dollars wasted in labor turnover will be reduced materially."

658.3

Suggestions for Improving Shop Management. F. J. Borer. *Railway Mechanical Engineer*, January, 1924. v. 98, pp. 39-40. Impartiality of foremen, meetings of supervisory forces, placing men on work for which they are best fitted, appreciation of good work and loyal service, affording opportunities for self improvement, fostering a good spirit, etc., as factors in strengthening the co-operation between the management and the employees.

658.3

The United States Employment Service —Service Monograph of the United States Government. By Darrell Hevenor Smith. 130 pp. The Johns Hopkins Press.

This book is one of a series of service monographs of the Institute for Government Research, dealing with the various activities of the government of the United States. The present volume gives a history of the employment service from its inception in 1907 down to the present time, and a discussion of the activities and organization as they now exist. The scope of its activity may be gaged by the fact that from 1908 to 1920 over eleven million persons had registered in the bureau, and that over eight million had been placed in jobs in agriculture and the industries.

658.3174

What Can the Employer Do to Encourage Saving and Wise Investment by Industrial Employees. C. J. Hicks. *Harvard Business Review*, January, 1924. v. 2, pp. 194-200. Some essential features of a plan for stock purchase, and a consideration of the various types of securities that may be offered to employees. Describes the stock acquisition plans of the Standard Oil of New Jersey, U. S. Steel Company and Eastman Kodak Co.

658.31513

Works Councils and Their Possibilities. Eric N. Simons. *Industrial Management* (London), December 27, 1923. v. 10, pp. 351-353. A discussion of some of the actual problems which can be effectively handled in conference. These are: Full time employment, Accident prevention, Employees' travelling facilities, General trade conditions, etc.

Production

658.58

An Analysis of the Work and Responsibilities of Maintenance Engineers. Daniel H. Braymer. *Industrial Engineer*, January, 1924. v. 82, pp. 10-16. Illus. With the help of its readers *Industrial Engineer* gives in this article details of actual jobs which show how the men responsible for the operation and maintenance of electrical and associated mechanical systems meet their problems. Charts and illustrations show the place which the maintenance work takes in an organization. Readers' comments follow.

658.58

Applying Machine Shop Methods to a Woodworking Job. D. R. Hampson. *Industrial Management* (N. Y.), January, 1924, v. 67, pp. 52-55. How a machine shop solved the problem of making a special kind of wooden box. By analyzing the proposition, reducing the job to its elementary forms, and tooling to suit, advantage over the woodworking plan was gained in accuracy and speed of production.

658.58

Classification of Locomotive Repair Shops. G. Armstrong. *Railway Mechanical Engineer*, January, 1924. v. 98, pp. 41-46. Well equipped roundhouses and shops increase the percentage of serviceable locomotives. Gives a detailed analysis of efficient shop operation in the roundhouse, in the intensive locomotive repair shop for quick repairs, and in the centralized production or manufacturing shop.

658.516

Economic Progress of Simplification. E. W. McCullough. *Iron Age*, January 24, 1924. v. 113, pp. 285-287. A summary showing what organized effort has done in its waste campaign in bringing about simplification. Best results have been accomplished in the lines where personal examination in making selections is not essential, such as in metals, paper and wood products. Much remains to be done in the clothing trades.

658.5

Extreme Variety versus Standardization. J. H. Van Deventer. *Industrial Management* (N. Y.), January, 1924, v. 67, pp. 36-46. The third of a series of articles. Turbine-generator production at Schenectady. A detailed description of the factors of production and production control in the manufacture of huge generators. Shows the necessity for many special drawings in most cases. Illustrations, including sample master schedule and progress report.

658.5

Finding Work for Idle Equipment. E. L. Shaner. *Iron Trade Review*, January 3, 1924. v. 74, pp. 7-10. Illus. Many companies are engaging in manufacture of secondary products to use equipment not in steady use. Supplementary work has often proved highly profitable.

658.516

It Paid Us to Cut Our Line 75 per cent. E. E. Curtis. *Factory*, January, 1924. v. 32, pp. 24-26. What was accomplished by simplification of lines in a brush factory. Led to more intelligent planning, greater accuracy in estimating costs, saving in packing and shipping, etc.

658.511

Job Analysis and Its Use; report of Committee on Job Analysis. *American Management Association*, 1924. 16 pp. A brief report showing how Job Analysis is carried on, its results and a list of industries using it.

658.58

Modern Maintenance of Plant and Equipment. W. G. Ziegler. *Industrial Management* (N. Y.), January, 1924, v. 67, pp. 24-31. Illus. Third of a series of articles. Paint as a vital factor in plant maintenance. Shows the value of proper painting of walls and ceilings, of painting pipes, machinery, etc. A small amount spent each year on keeping surfaces in good condition is a profitable investment.

658.5

Organization of the Production Division. F. A. Waldron. MANAGEMENT AND ADMINISTRATION, February, 1924, v. 7, pp. 173-176. Covers the Division office, Discipline, Working capacity, Tolerances, Preparation of work, Speeds and Feeds, Piece-rates and Time study. Gives many sample record forms.

658.53

Providing the Engineer with Service Data. O. T. Kreusser. *Society of Automotive Engineers Journal*, January, 1924. v. 14, pp. 63-67, 73. Gives suggestions for a simple chart system to be used in all automobile service stations, for keeping a record of the nature of every repair and adjustment job. These charts, consolidated in one master chart, reveal current troubles, permit an immediate check on what is happening in all sections of the country, and enable the engineer to determine what it is necessary to do in order to correct or eliminate difficulties. Sample chart given.

658.5671

Reclamation Plant for Miscellaneous Equipment. R. K. Graham. *Industrial Engineer*, January, 1924. v. 82, pp. 21-23, 46, 52. Illus. Describes Corwith plant of the Santa Fe Railroad where discarded and broken-down equipment is rebuilt and scrap put into usable or

salable form. "Can it be reclaimed at a profit" is the deciding factor.

658.53

The Works Records Department. W. J. Hiscox. Article II. *Industrial Management* (London), December 27, 1923. v. 10, pp. 354-355. This, the third article of the series, deals with *Delays*. Forms are given showing how statistics are compiled to make clear the causes of delay. The article is to be continued.

Selling

658.801

Consumers' Buying Motives. Melvin T. Copeland. *Harvard Business Review*, January, 1924. v. 2, pp. 139-153. An analytical study of buying motives. These are grouped under three headings: Instinctive, Emotional and Rational, and the author gives in great detail the results of an examination of 717 advertisements in current periodicals as studied from these angles.

658.82

Designing the "Plant Layout" of an Advertising Campaign to Secure Retail Distribution. R. L. Burdick. *Advertising and Selling*, February, 1924. v. 34, pp. 15-16. Working out an advertising campaign along machine lines. Getting the arguments and methods into engineering terms and designing the campaign so that the matter of cost will be the last consideration.

658.88

Dissecting Delinquent Accounts. Lucien Kellogg. *Business*, February, 1924. v. 5, pp. 30 and 46. Explains a delinquent account record based on the formula: new balance plus cash, minus old balance, equals net purchases. With this record, the credit manager is able to lay out his collection campaign for the month. Sample form is given.

658.8

The Handbook of Sales Management. By S. Roland Hall. 995 pp. McGraw-Hill Book Co.

This book differs from the usual handbook in that it is written in a breezy style that is quite a contrast to the ordinarily concise language of such works. It resembles them, however, in being packed with data and illustrative matter covering practically all phases of the subject with which it is supposed to deal. The organization of a sales department, the recruiting, educating, directing, and developing of salesmen, salesman's reports, letters, and expense accounts, the salesman's knowledge of credits, and telephone salesmanship are some of the features relating directly to the sales personnel that the author discusses more or less exhaustively. These discussions are buttressed by numerous examples from the practice of many successful organizations. Other subjects that come in for attention are the formulation of sales policies, research and analysis of markets, the use of statistics, charts, and records, quota systems, and standard tasks, sales contests, conventions and conferences, and sales plans and campaigns. The use of advertising as an aid to sales work is discussed, and the knowledge that the salesman should have of advertising and how he can make it effective are illustrated by practical examples. The book appears to be a good one, and should prove a valuable assistant to the sales manager.

658.82

How a Distributing System for Olive Oil-Gas-Burner Grew from Mail Order Advertising. G. A. Nichols. *Printers Ink*, January 10, 1924, v. 126, pp. 157-158, 160, 165-166, 168. Business evolved from a mail order proposition to one of direct personal selling. Country now divided into sales districts with sales direction under district managers. Each distributor must maintain a definite selling quota, yet every woman in a rural community may become a local distributor, and she may profit thereby.

658.82

Industrial Growth and its Effect on Marketing Problems. Stanley Resor. *Advertising Fortnightly*, January 16, 1924. v. 2, pp. 17-18, 52. How to sell the products the people don't want, because they don't know about them. The problem for the advertising agent is to interpret hidden values and technical superiorities of products in simple, human terms, and keep constantly in mind the educational factor.

658.81

The Market Survey — Finder of Unknown Sales Appeals. Percival White. *Printers' Ink Monthly*, February, 1924. v. 8, pp. 80, 83-84, 87. Field investigators' valuable accessory to sales manager's department. Questions of who does the buying, and why, have often revealed uses for articles for which they were never intended, thus suggesting new sales possibilities.

658.87

The Merchants Manual. Edited by Lew Hahn and Percival White. 614 pp. McGraw-Hill Book Co.

This book, representing the work of a large number of specialists in retail store operation and management who have contributed to it, covers every phase of merchandising from the standpoint of the merchant in direct contrast with his customer. It deals with the problems of location and structure, layout and equipment of the store; of operation, including the factors of receiving, storing, packing, shipping, delivering, manufacturing, and purchasing; of store organization and management, comprising also such questions as finance, insurance, sales-check systems, credits and collections, statistics and accounts, expenses and budgets; merchandising, including control, buying, stockkeeping, mark-up, profits and turnover, advertising, display and sales and selling problems, and sales direct by mail; personnel matters, such as sources and selection, training and education, records, promotion, remuneration and service to employees; and special service to customers and relations with customers. The book is an attempt to put into writing some of the principles of good store operation and management. It is modeled on the engineering handbooks, and fills, in a measure, the same field—that of a reference book and guide. The subject matter is drawn from the practice of a large number of successful stores in many different fields in all parts of the country. The small merchant, as well as the large department store operator, will find in its pages much that is of value to him in the present conduct of his business, and also in planning for its future extension.

658.82

Our Dealers Help us Run Our Business. Fletcher H. Montgomery. *Advertising Fortnightly*, January 30, 1924. v. 2, pp. 11-12, 36. The Knox Hat Company has put the retailers' knowledge to constructive use by forming an Advisory Council made up of five retail agents and five representatives from Knox. New and changed policies are discussed in this Council and mutual benefits result.

658.808

Sales Control that Reveals Weaknesses in Working Territories. Martin Hastings, Jr. *Printers' Ink Monthly*, February, 1924. v. 8, pp. 39-40, 124. Charts. Control necessary in order to force salesmen to cover their territory thoroughly. System used by the Tide Water Oil Corporation includes daily reports to supervising salesman and tabulations from which sales analysis can be made.

658.82

Sales Doubled When Modern Ideas Took the Place of Old. August Belden. *Printers Ink*, January 17, 1924, v. 126, pp. 41-42, 44. Edward N. Riddle Co. of Toledo, manufacturers of lighting fixtures reorganized its production department and sales methods, and in one year doubled sales of any previous record. Eight fundamental principles were followed, among them: Simplification of lines, 4000 units were reduced to 40; Standardization of manufacture; Standardization of selling methods and Definite schedule of prices.

658.807

The Sales Manual. What it Should Contain and How to Prepare it. John Allen Murphy. *Printers' Ink Monthly*, February, 1924. v. 8, pp. 23-24. Illus. Manual, merely a book of instructions, based on information previously collected. Makes available to every salesman best possible answers to questions they may be called upon to answer.

658.82

The Science of Marketing by Mail. H. J. Buckley. *Forbes*, January 5, 1924. v. 13, pp. 391-392. Mail advertising establishes a reliable sales basis, enables the manufacturer to feature his line regularly before the trade, and assists the salesman to establish the prestige of the business. This is the eighth article in the series.

658.82

The Science of Marketing by Mail. Homer J. Buckley. *Forbes*, February 2, 1924. v. 13, p. 511. Last article in the series showing the many opportunities for advertising by mail.

658.82

Sounding Out Consumer's Preferenees in Advance. Leonard Etherington. *Printers Ink*, January 17, 1924, v. 126, pp. 89-90, 92. The best way to find what styles are going to fit the fancy of the public is to ask the public. Charles S. McNulty of the Decorative Metal Co., Taunton, Mass., relates how several styles of boudoir lamps were shown to representative groups of women and their suggestions adopted to determine styles to be manufactured.

658.85

A Successful Method of Selecting and Developing Salesmen. C. C. Henshaw and R. S. Riehey. *Printers Ink*, January 17, 1924, v. 126, pp. 129-130, 133. A comprehensive report on methods employed by an executive of twenty-five years' experience in choosing and training a motor car sales staff. Gives steps followed in training individual salesman.

658.82

Why We Get All-Around Dealer Cooperation. Bertrand J. Cahn. *System*, February, 1924. v. 45, pp. 167-171, 201. Illus. Manufacturers must increase the dealer's net profits to insure their own success. This can be done by making a survey of the seller's community through a budgetary control of buying, training salesmen to serve as advisers to their customers, etc.

Technical

621.3923

Arc Welding and Cutting Economics. A. M. Candy. *Industrial Engineer*, January, 1924. v. 82, pp. 27-29, 45. Illus. Reduction in cost of labor as experienced by manufacturing firms and railroads using electric arc welding and cutting. Many cases are cited stating problems and results achieved.

62(064)

Betriebstechnische Wanderausstellung in Berlin. A. Heller. *Zeitschrift V. D. I.*, November 24, 1923. v. 67, pp. 1069-1071. Presents main features of a comprehensive engineering exhibition held in Berlin, Oct. 27th to Dec. 2d, 1923. Labor saving devices and new machinery exhibited by the Reichsbahn, the Reichspost and many industrial firms are described. Management for greater efficiency is emphasized throughout.

621.138

Classification of Locomotive Repair Shops. G. Armstrong. *Railway Mechanical Engineer*, January, 1924. v. 98, pp. 41-46. Well equipped roundhouses and shops increase the percentage of serviceable locomotives. Gives a detailed analysis of efficient shop operation in the roundhouse, in the intensive locomotive repair shop for quick repairs, and in the centralized production or manufacturing shop.

621.313

Extreme Variety versus Standardization. J. H. Van Deventer. *Industrial Management* (N. Y.), January, 1924. v. 67, pp. 36-46. The third of a series of articles. Turbine-generator production at Schenectady. A detailed description of the factors of production and production control in the manufacture of huge generators. Shows the necessity for many special drawings in most cases. Illustrations, including sample master schedule and progress report.

621.175

Profit Possibilities of Vacuum in the Power Plant. J. T. Beard, 2nd. *Industrial Management* (N. Y.), February, 1924. v. 67, pp. 115-119. Illus. "Steam in the average industrial plant serves two distinct purposes: the actuating of prime movers for generating mechanical and electrical power, and the generation of heat for processes and for buildings. It is this twofold use which, in many cases, makes the attainment of central-station standards of economy impossible. Nevertheless, in a large number of cases, the possibilities of condenser operation have been overlooked. What these possibilities are and how to realize them form the subject matter of this article."

Training

658.386

Economies for Employees; Report of Committee on Economics for Employees. *American Management Association*, 1924. 19 pp. Survey shows that several national organizations and educational institutions are meeting the need for courses in economics. Corporations are also reaching their employees through lectures, house organs, group discussions, etc.

Transportation

656.124

Economies of Motor Transport. By George W. Grupp. 414 pp. D. Appleton & Co.

A book that deals with the economics of the motor truck, rather than with its physical aspects of construction, operation, and maintenance, is a welcome addition to the flood of literature concerning the automobile. This book has collected the facts and basic principles underlying the use of the automobile as an economic factor in the transportation of goods and passengers, and presents them in such shape that they may be readily applied to every class of business. To the man contemplating the replacement of horse-drawn vehicles with motor equipment, it will present the facts that will enable him to select the proper equipment for his case, and to draw up a plan for its most efficient operation. Actual figures of costs are used sparingly for the reason that costs are influenced by so many factors peculiar to the individual case that figures might easily be misleading in discussing the general case. The principles of accurate costs are given, however, so that the truck owner may easily lay out the system to fit his particular needs. The book discusses such practical subjects, among others, as when to replace horses with motors, the selection of equipment, loading and unloading, roads and routing, operating problems, motor-truck performance, truck abuses, truck maintenance and inspection, cost of operating trucks, motor-truck overland haulage, personnel and organization, and legislation. Six appendices give data on history of the motor-truck industry, motor-truck clubs, advertising, ton-mileage, insurance, and weights of the materials commonly hauled by motor truck.

Wages

658.3225

Applying the Bonus System to Diversified Operators. C. E. Bassett. *Industrial Management* (N. Y.), January, 1924. v. 67, pp. 47-51. Describes in detail a plan which has worked out successfully in individual work and in gang work of various kinds.

658.3225

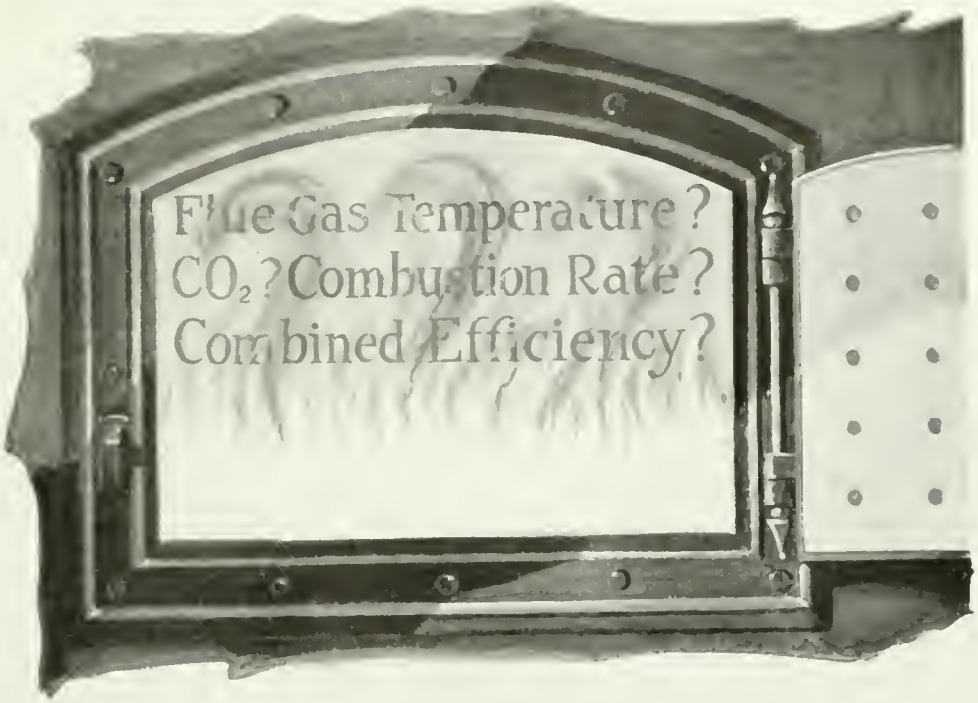
Financial Incentives for Employees; Report by Committee on Remuneration for Employees, with Convention Discussion. *American Management Association*, 1923. 30 pp. Indicates what methods of wage payment are in use, shows the relationship between the wage system and foremanship, inspection, planning, and accounting; suggests methods of applying incentives to workers on non-repetitive operations; and indicates the advantages and disadvantages of typical wage plans. Includes a 6-page bibliography.

658.3215

The Wage Bargain and the Minimum Wage Decision. Franklin Winton Ryan. *Harvard Business Review*, January, 1924. v. 2, pp. 207-218. The recent decision in the U. S. Supreme Court that a minimum wage law for women and children is unconstitutional has led the author to work out in this paper a more exhaustive analysis of the wage bargain than was done in the decision, and so prove a fundamental economic law.

658.323

"Family Wage" System in Germany and Certain other European Countries. Mary T. Waggamon. *Monthly Labor Review*, January, 1924. v. 18, pp. 20-29. No industry in Germany had wholly ignored this method of payment. The form the payment takes is discussed and labor's attitude towards such a system. Also describes briefly the systems in Australia, Czechoslovakia, Denmark, Finland, the Netherlands, Norway and Sweden.



Your furnace —as an expert sees it

STOKER MANUFACTURERS ASSOCIATION SMA

Ten cars of coal—or nine?

Mechanical stokers save coal by increasing furnace efficiency. They also make it possible to burn cheaper grades and sizes of local coal. Ten per cent saving is a conservative estimate.

Five men or three?

Stoker firing will cross at least two men off the pay roll if adopted by a hand fired plant now requiring five men. The better working conditions appeal to a better, steadier class of men.

Four boilers or three?

Greater steam demands can be met without adding to your present boiler equipment. Three boilers can be made to do the work of four through the higher combustion rate made possible by—

STOKER FIRING

TO a combustion engineer the fire in your furnace is not simply a blinding blaze but a series of chemical reactions and controllable factors. He knows through chemical analysis exactly how much heat and steam each pound of your coal should produce. To him, sweating firemen and a general bedlam in the boiler room are not acceptable evidence that the maximum of heat is being given up by the coal.

On the contrary, the combustion engineer's test is an accurate calculation that takes into consideration temperature of feed water, coal analysis, steam pressure, quantities of water, coal, and the many other elements which enable him to establish furnace and boiler efficiency with scientific certainty.

Mechanical stokers have been developed by combustion engineers and are installed in your plant by combustion engineers on a basis of insuring better results. When you install mechanical stokers you get not only highly developed stoking machinery, but the best of engineering counsel as well.

It is this combination of service and equipment that makes fuel saving, labor reduction, and smokeless operation a foregone conclusion before the installation of mechanical stokers is even begun.

The part that engineering has played in mechanical stoker development is told in the free book, "Coal—The Basic Fuel."

A card to the secretary of the association brings a copy to you—free.

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BURN COAL

"The *basic* fuel"

STOKER MANUFACTURERS ASSOCIATION

G. A. Sacchi, Secretary, Lester Branch, Philadelphia

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The Ronald Press Company, Publishers, 20 Vesey Street, New York, N. Y.

Have you a brake on every shaft ?

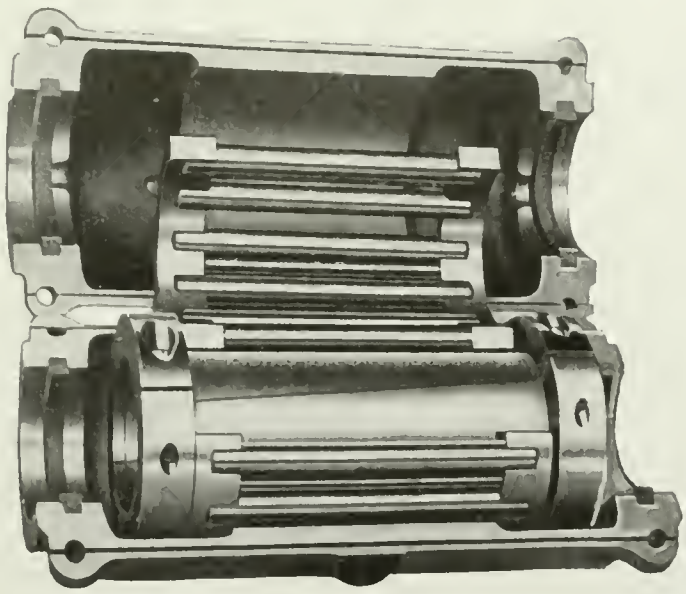
You have if you are using the old power wasting bearings. Think of this, will you—15 per cent of the power that you are now wasting can be saved. Figure that out in dollars, tons of coal or kilowatt hours—then

Put in Sells Roller Bearings

They fit your hangers, post hangers and pillow blocks—no added expense. Nothing to throw away but your old bearings and you will be glad to get rid of them—Just imagine for every $7\frac{1}{3}$ years that they have operated they have wasted an entire year's supply of coal which easily could have been saved.

Our Engineering Department is ready—right now—to go into your transmission problems whether you require half a dozen bearings or several hundreds.

For dealer nearest you see MacRae's Blue Book



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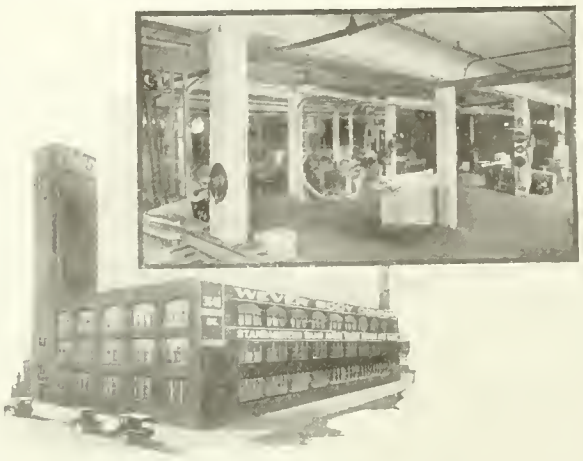
The Bearing that is past the experimental stage



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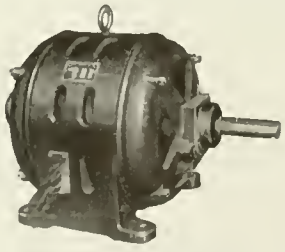

May we relieve you of your power problems? We shall be pleased to send one of our engineers to confer with you.

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J. H. BLISS, C.P.A. (Ill.)
Comptroller
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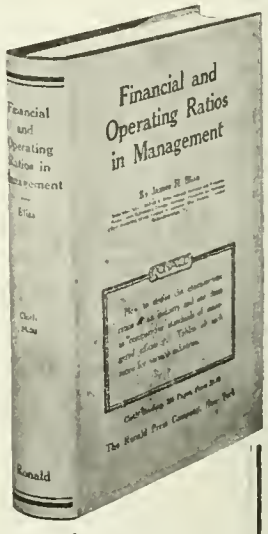

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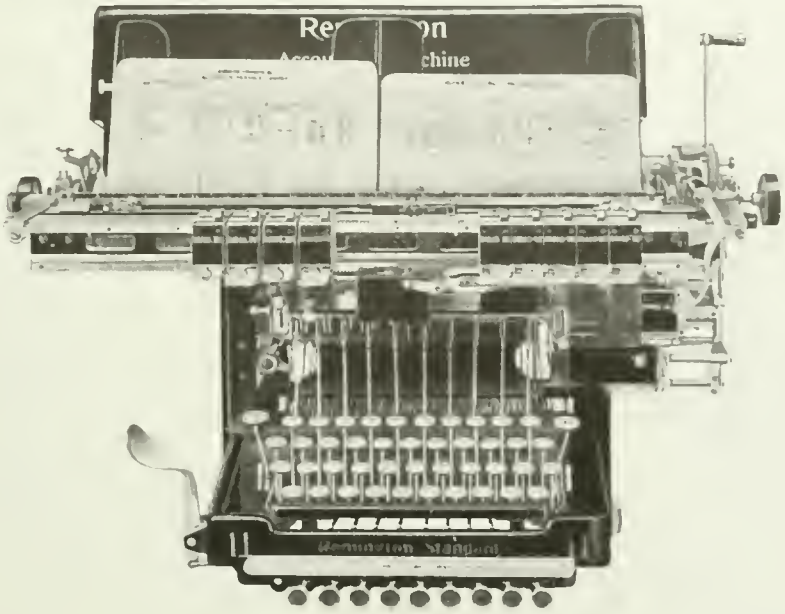

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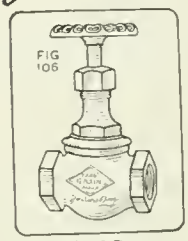
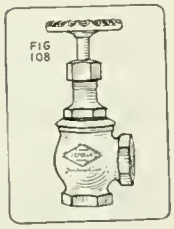


Standard Bronze Globe Valve, Screwed



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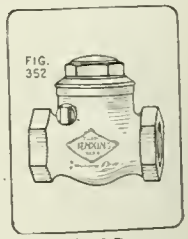
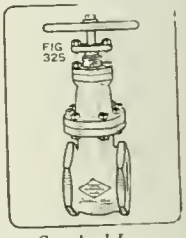
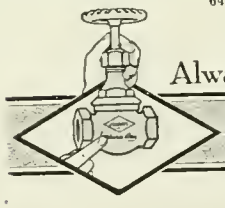


Standard Bronze Swing Check Valve, Screwed



Standard Iron Body Gate Valve, Screwed



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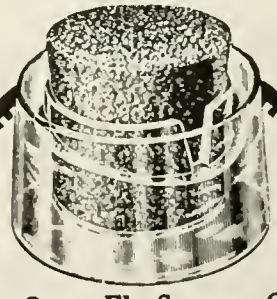

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Upper Left

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Globe-Wernicke Steel Upright File
Lower Left

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Upper Right

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Structural Strength Safe
Lower Right

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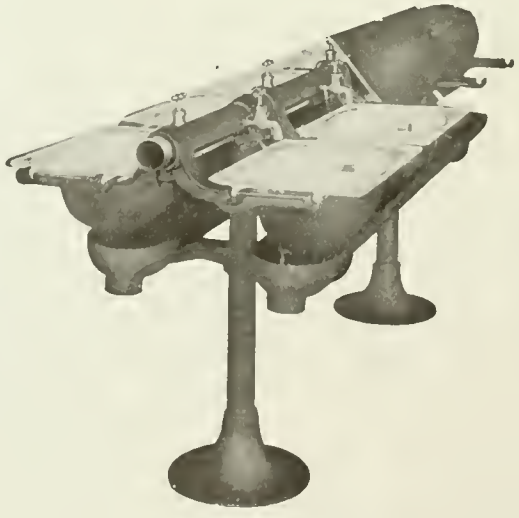

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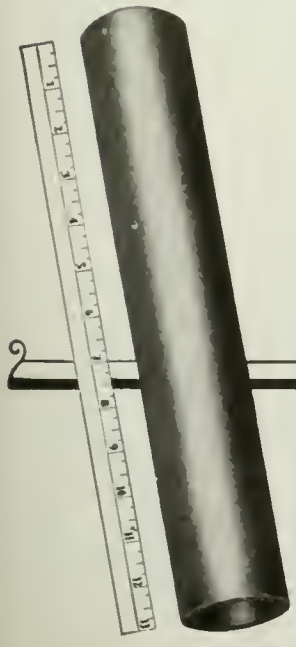

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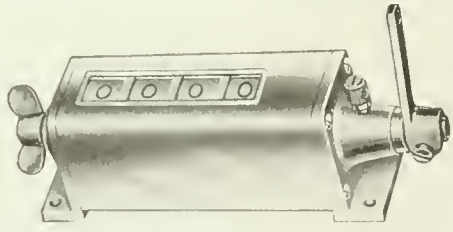

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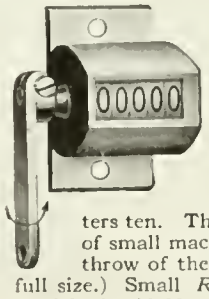

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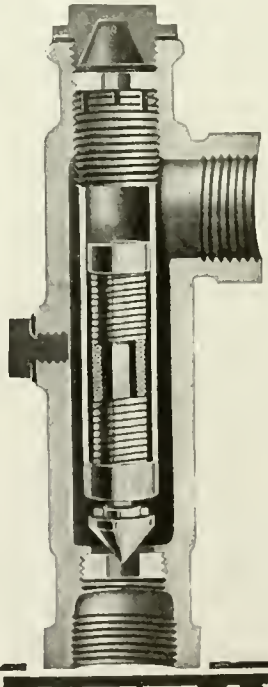

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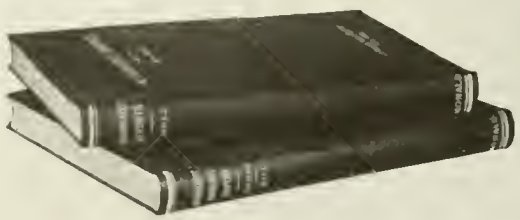

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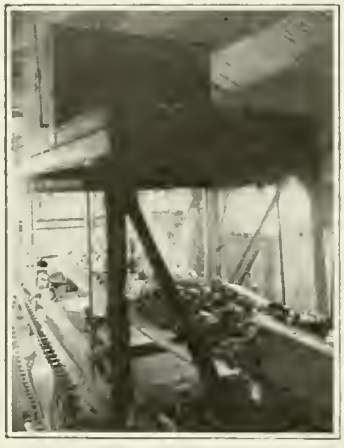

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Royersford Foundry and Machine Co.

Roller Bearings, Tapered, Plain and Babbitt
Hyatt Roller Bearing Co.
Royersford Foundry & Machine Co.

S

Safes
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Scrapers, Cable Drag
Industrial Works

Seamless Steel Containers
Seamless Steel Products Co.

Shafting
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Stoker Manufacturers Association

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Tax Service
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Calculagraph Co.

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Calculagraph Co.

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General Electric Co.

Traps, Steam
Sarco Co., The

Typewriters
Remington Typewriter Co.

Turbines, Steam
General Electric Company

V

Valves
Jenkins Bros.

Valve Fittings
Jenkins Bros.

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Valves, Radiator
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Voltmeters
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W

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MANAGEMENT AND ADMINISTRATION

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Vol. VII

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Cover Illustration of Cotton, Carding, and Combing Room, Whittenton Manufacturing Company

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Authors and Articles in this Issue

"MAINTAINING a Profit With Reduced Prices," by **E. A. Munschauer**, describes methods the introduction of which increased the output of refrigerators in his factory by 50 per cent, and this without any material increase of plant or equipment. The methods employed are simple and applicable to any factory confronted with a similar problem. By the extension of the same methods Mr. Munschauer expects to increase his output 100 per cent.

J. H. Bliss, Controller of Libby, McNeill and Libby, in "Control of Fixed Property Investments" discusses investments in plant and equipment "in which and by which the operations of a business are conducted". As stated by Mr. Bliss, "There is no matter of greater importance to an industrial concern than the determination of the policies governing its expenditures for fixed property investments". The present article is the fifth of the series "Capital Requirements and Control".

Robert T. Kent is a mechanical engineer and a well-known writer on industrial topics. In "A Conveyor System that Revolutionized a Cotton Mill" he describes a method of mechanical handling that has resulted in an entirely new plan of manufacturing, at the same time "Completely changing the viewpoint of management. The present article considers the conveyor simply as a machine for transporting material. A subsequent article will analyze its effect on the work and personnel of the mill.

In "Pricing Policy Applied to Financial Control," **Donaldson Brown**, Vice-President of General Motors Corporation, applies the principles of price-fixing laid down in his two preceding articles. While Mr. Brown recognizes expressly the fact that "ordinarily prices cannot be fixed according to mathematical rule or at figures calculated to yield a pre-determined rate of return," the conditions which lead to any apparent departure from the expressed policy must be studied to determine whether a modification of policy is required, or whether the conditions are of temporary import. The three articles together constitute an able and unusual discussion of the problem of pricing.

Frederick C. Mills, in "Factors Affecting Wages and Other Shares in the Product of Industry," discusses a problem of the first importance to manufacturers. As pointed out by Professor Mills, any wage system is in effect a sharing of product, and any sharing of product must, to result in any stable prosperity, take into account: (1) the welfare of labor; (2) the maintenance and proper increase of capital equipment; and (3) the maintenance unimpaired of the productivity of the economic system. The article is the third of the series "Economic Problems of Industrial Organization".

"Organization of the Accounting Division," by **Frederick A. Waldron** is the fourth article of the series, "A Co-ordinated System of Planning, Routing, and Cost Accounting". In this article Mr. Waldron describes a cost mechanism that will give all necessary data as to costs and conditions in the factory and afford an adequate basis for production control. As to the requirements he says: "An accounting method which gives accurate results must be simple and direct with as few clerical transferences of original data or figures as possible. It should also fit in and become part of the production control".

It is but seldom that the smaller factory receives the attention of expert organizers and accountants. In the series of articles "Profitable Methods for the Small Factory," **Geoffrey C. Brown** discusses this problem, and in the present article, "Time Study and Standardization," the third of the series, he considers specifically the matter of time studies in factories of moderate size. Here such studies are considerably facilitated by the close and friendly relations that exist, or should exist, between the management and the working force, resulting in favorable conditions which have "no parallel in the large organization".

William R. Basset, in "Profits from Better Equipment," emphasizes the importance of utilizing mechanical equipment wherever it can be done to advantage, and of then maintaining this equipment at the highest point of operating efficiency. As stated by Mr. Basset, "The concern . . . . alert to substitute mechanical power for man-power, is nearly always more profitable than the one . . . . that thinks men are cheaper than machines".

The cover illustration—the cotton, carding, and combing room, Whittenton Manufacturing Company—was secured through the courtesy of Charles T. Main, Engineer.

Good-Will

All business has a *Soul* as well as a *body*. The body is factory or store, organization and goods. The *Soul* is the stamp on the public mind.

When that stamp is impressed by the desire to serve, by faith in the merit of the product, by courtesy, square dealing and sincerity of purpose, the reaction is Good-Will.

The potency of Good-Will is measured by its *earning power*. Earning power is the reflection of Service. When Service merits compensation *beyond* the current rate of interest on tangible assets it becomes Good-Will.

Good-Will is the personality of business. So long as Faith and Service are maintained Good-Will *must* grow; it cannot die.

The mark of personality is a great asset. Represented on the Balance Sheet or not, it can and should be periodically appraised on a scientific basis, its contributing factors determined and its value definitely known.

There is a well defined method of establishing the material value of Good-Will. It is based on *certain* facts and figures—carefully defined—accurately estimated.

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THE PUBLISHERS' PAGE

The Southward Trend of Manufacturing

SOME of our southern states have natural and economic advantages peculiarly adapting them for manufacturing. A mild, equable climate, proximity to sources of raw materials, cheap, plentiful power, a large supply of white, English-speaking labor, and good shipping facilities for both domestic and foreign trade are among these advantageous factors.

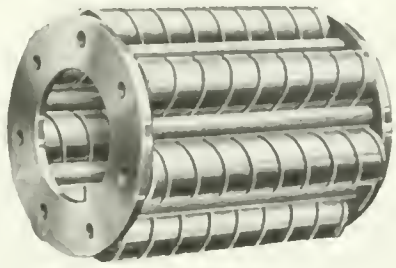
A district unusually well favored in these respects is the Upper Piedmont comprising the western parts of North and South Carolina. In an area approximately 250 miles long by 75 miles wide are upwards of 450 good-size industrial plants, including the largest spinning mill and the largest hosiery mill in the world, and the first city for manufactured tobacco and the second for furniture in the United States. Since the boom period following the war no other manufacturing district of this country has had such a rapid, consistent, and diversified growth as the Upper Piedmont. This record is in sharp contrast with the many which have shown declines or but little progress.

For these reasons Ralph G. Macy, an engineer and executive of unusually broad experience, already familiar with general conditions in the southern country, was commissioned by MANAGEMENT AND ADMINISTRATION to make a thorough investigation of the industrial growth and conditions of the Upper Piedmont district—and this with particular reference to its development since 1918. Mr. Macy is now in the midst of this work and is preparing a series of articles presenting adequately and interestingly the underlying causes which are bringing about the present strongly marked southward trend of manufacturing development.

Each article of this series will take up a different phase of condition or development, the series as a whole giving a clear and illuminating picture of what has been accomplished and what is now going on in this important section of the industrial South.

The May number of MANAGEMENT AND ADMINISTRATION will contain the first article of Mr. Macy's series, and succeeding articles will appear each month thereafter until the presentation is complete.

Built into the New as well as into the Old



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Loads transported may range from feather pillows to pig iron, and the trucks must always be easy to pull. The Hyatt roller bearing equipped wheels, which are standard for all Stuebing lift trucks, roll easily and smoothly across floors and speed delivery of the load at its destination, whether that be a few feet or many.

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CONDITIONS AND PROSPECTS IN BUSINESS AND INDUSTRY

PREPARED BY LEWIS H. HANEY

Director, New York University Bureau of Business Research [1]

Barometer of Industry and Trade

Probability of a Set-back in Business Looms Up

General Forecast. The forecast this month is not so favorable as the one which seemed warranted 30 days ago. Further gains in production and in volume of business will occur during the next two or three months; but irregularity and caution will continue, and a renewed business recession is probable. This recession may be looked for about the middle of the year. Present indications are that it will not be either sharp or violent.

The main line in the barometer, the P/V Line (see Fig. 1), has taken a downward course. Final data for January caused the three months' moving average to turn down, and February data indicate a further decline. The bars which show the excess of failures over normal ceased to grow shorter in February, which reflects a continued irregular condition of business. The price arrows now point downward. Continued ease in money and a higher reserve ratio both indicate the lack of any great demand for funds. The ease in money and credit, however, prove that *no sharp break is in prospect and the business setback which is here forecast will not be of a major character.* No major downturn is yet in sight.

Recent Developments. The most marked February developments were:

1. There has been a continuation of the rapid growth in production in basic industries and in railway tonnage.
2. Retail trade and bank debits have continued to increase, but at a less rapid rate than production.
3. The rate of increase in unfilled steel orders has been checked.
4. The general price trend is slightly downward and there has been a lack of firmness in the iron and steel markets.
5. Failures have increased slightly in number.
6. The increase in building activity has been checked.

The two outstanding conditions in business are the lack of confidence in the future which prevails, and the rapid gain in production as compared with prices.

[1] Assisted by Horace J. Barney, Harry Comer, and Stephen DuBrul of the Bureau's Staff.

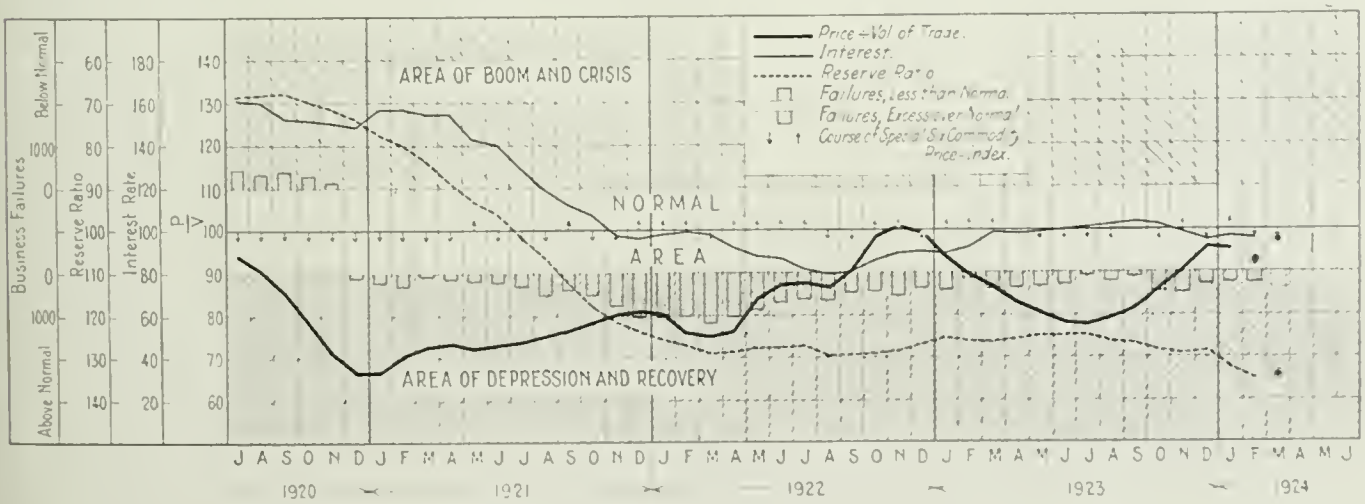

AREA OF BOOM AND CRISIS
NORMAL AREA
AREA OF DEPRESSION AND RECOVERY
Price + Vol of Trade.
Interest.
Reserve Ratio
Failures, Less than Norma.
Failures, Excess over Normal
Course of Special Six Commodity Price Index.
Business Failures
Below Normal
Above Normal
Reserve Ratio
Interest Rate
P/V
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1920
1921
1922
1923
1924

FIG. 1 THE BAROMETER OF INDUSTRY AND TRADE

The P/V line (drawn heavy) is the business forecast line. It shows the trend of commodity demand, and is the ratio between Bradstreet's index of wholesale prices and the physical volume of trade (carloadings times tons per car), based on 1912 as the normal year. It is plotted as a three months' moving average, centered successively on the middle months, except that the final dotted portion of the line runs to the actual figure for the last month. A rise in the curve indicates increasing demand, and vice versa. The interest rate curve has been corrected for seasonal variation, and index number 100 equals 5 per cent. The federal reserve ratio of cash reserves to note and deposit liabilities is inverted to harmonize its indications with the rest of the curves, and is corrected for seasonal variation. Business failure bars are based on Dun's reports, and normal is taken as the trend for 40 years. The six-commodity price index is based on special investigation by the N. Y. U. Bureau. March 1924 data shown are probable trends. Areas in which curves lie indicate that business is good, normal, or poor.

The lack of confidence, while it is not new, has gained in significance as time has passed. Hand-to-mouth buying and small forward orders continue, and in all speculative markets the "outside interest" is notable for its absence. This situation, while it may be called psychological, is important, and as long as it exists business is not going to forge ahead very rapidly. The situation has been variously ascribed to European conditions, the oil investigation, tax uncertainty, etc. At bottom, however, it rests upon the continued irregularity in prices and profits (which in turn go back to the production situation referred to in the following paragraph). While some industries are showing high net earnings, others are facing reorganization. Prices are so low compared with costs that in many industries it is doubtful if the increasing volume of production will mean increased net earnings.

A large part of the situation is covered by saying that *the production of commodities is going ahead at too rapid a rate.* Production is up, but prices are hardly firm—perhaps are weak. This indicates that *the demand situation has been weakened and consequently the outlook for maintaining prices with an increasing volume is not so bright.* It now seems that recovery in productive activity may be overdone, in the sense that markets will not take the volume of goods without price reduction. In the oil industry the situation has become much stronger, but in such basic industries as iron and steel and copper, the outlook for further gains is not so bright. It is this situation which is reflected in the downward course of the P/V Line.

It is possible that the improved appearance of the business *future* which developed last fall, and which appears to have ended in January, may return in two or three months, if the anticipated recession proves mild. If this is to be the case, however, either (1) production must soon be checked, or (2) there must be a marked improvement in demand with a stronger price situation, or (3) there must be a combination of both these developments. At present, little prospect of an early decrease in production exists, and the momentum already gained should carry the output of basic industries and railway tonnage further upward.

The chief hope, therefore, of an improvement in the business outlook lies in the development of stronger demand. On this side of the problem we must consider (1) domestic purchasing power, (2) European demand, and (3) the possibility of inflation.

As to domestic purchasing power, it may be noted that the tendency of wages seems to be slightly upward, while the cost of living is little changed, but if anything slightly lower. Employment holds up well. Buying in rural communities has gained somewhat. Altogether the level of purchasing power appears to be well maintained. The European outlook is distinctly encouraging. With some settlement of the reparations problem in sight, this condition may well lead to a better demand from abroad. No signs of inflation are at hand.

In view of these facts the most reasonable conclusions are that: (1) production will rise for two or three months, but will have to be checked by sagging prices; and that (2) this will not require any drastic readjustment. With high domestic purchasing power and easy money, and with improved foreign buying, the adjustment of supply to demand should be relatively easy. Greater knowledge of conditions and observance of caution can be relied upon to make transitions more prompt and less violent than formerly. What may follow in the autumn cannot safely be predicted. A declining level of production in basic industries seems probable, but whether this decline will be checked early by improved demand or be followed by a period of dull and declining business, it is yet too early to attempt to say.

Favorable and Unfavorable Factors. A list of the favorable and unfavorable factors, as they appear in the middle of March, is as follows:

Favorable Factors

1. Bank debits increase. (Fig. 9)
2. Mail order sales increase. (Fig. 10)
3. Unfilled steel orders increase. (Fig. 3)
4. Capitalization of new enterprises increased, allowing for seasonal variation.
5. Money and credit easy. (Fig. 13)
6. Heavy production and sales without "pyramiding" of inventories.
7. Continued caution in buying.
8. Improved European situation.
9. Radical legislation improbable.
10. Tax reduction probable.
11. High purchasing power.

Unfavorable Factors

1. Business failures slightly increased.
2. Decreased building activity. (Fig. 6)
3. Slight decline in price level. (Fig. 11)
4. Great irregularity in industry (silk, cotton, coal, copper, leather, fertilizers, tires).
5 Soldiers' Bonus Law probable.

Future Dangers

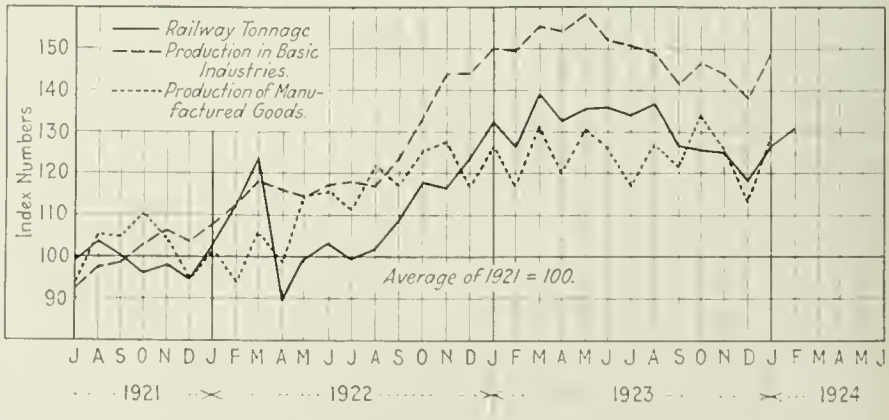
1. The possibility of overproduction, in the sense of increasing output so rapidly that goods must be sold at a loss or at decreased profits.
2. Increased volume of sales based on credit (houses, automobiles, radios, furniture, etc.).
3. Termination of the building boom.
4. Bidding up of wages.
5. Withdrawal of European capital.
6. Inflation in credit.

Business men should carefully watch such indicators of demand as unfilled orders and sales at retail and wholesale; the trend of prices should be carefully scrutinized, and great care should be exercised not to go ahead too fast with production schedules.

Production and Stocks of Commodities

Production Still Gaining: Stocks Undergo Changes

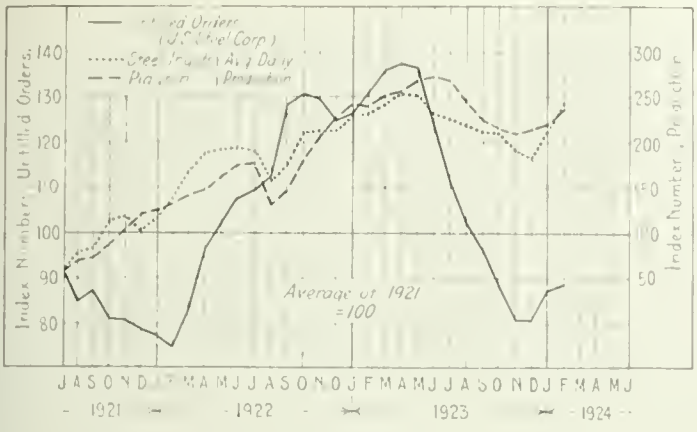
The indexes of the stocks of important commodities, Table 1, show several decreases, notably in leather and gasoline. The leather index on February 1, was 9 per cent below the previous month's level; while *gasoline stocks, after cor-*



Sources, Federal Reserve Board, N. Y. U. Bureau of Business Research

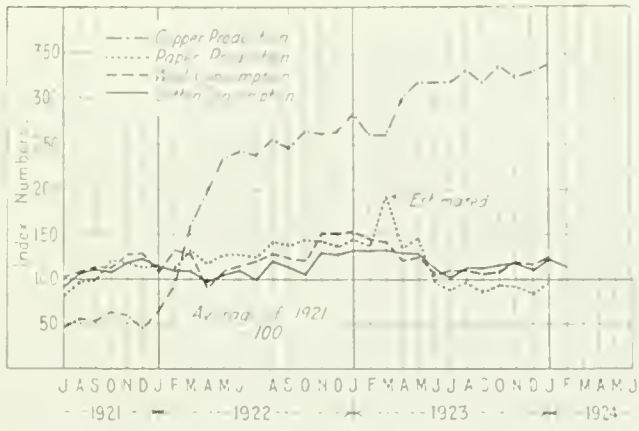
FIG. 2 RAILWAY TONNAGE AND PRODUCTION IN INDUSTRY

Railway tonnage and production in basic industries corrected for seasonal variation, and the latter also for normal growth.


Index Numbers, Unfilled Orders
Index Number, Production
Average of 1921 = 100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Iron Age, American Iron and Steel Institute

FIG. 3 IRON AND STEEL PRODUCTION AND UNFILLED ORDERS
Corrected for seasonal variation.


Copper Production
Paper Production
Index Numbers
Estimated
Average of 1921 = 100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, American Bureau of Metal Statistics; American Paper and Pulp Association; Bureau of Census; Dep't of Commerce.

FIG. 4 PRODUCTION IN FOUR IMPORTANT INDUSTRIES
Cotton and wool corrected for seasonal variation.

rection for seasonal variation, show a decrease of 15 per cent. Newsprint paper stocks, however, are larger, but this seems to be a normal seasonal accumulation.

As was predicted last month, merchant pig iron stocks as of February 1 showed a decrease, which amounted to about one-half of one per cent. This index will probably rise again in February.

Production and Railway Tonnage

Railway Tonnage. After allowing for seasonal variation and for a leap-year February, the tons originating on Class 1 railways gained considerably, the index increasing from 127 in January to 129 in February. See Fig. 2. (The average for 1921 = 100).

Production. The production in basic industries increased sharply in January, rising from an index number of 138 in December to 149.2 in January. *Production has practically regained the level reached a year ago.* The production of manufactured goods increased even more rapidly. (See Fig. 2).

Conclusion. The year 1924 has begun with a high level of production and the trend is upward. Undoubtedly the momentum gained will carry the increase in industrial output further. The question is, are we going ahead too fast? It is to be noted that *the index to production in basic industries has increased more rapidly than railway tonnage, which suggests the possibility that stocks of such commodities may begin to accumulate.*

TABLE 1. STOCKS OF IMPORTANT COMMODITIES ON THE FIRST OF THE MONTH
(Index Numbers: Average for 1921 = 100)

MONTH AND YEAR	GASOLINE*	LEATHER (Cattle)	ZINC	NEWSPRINT PAPER	AUTOMOBILE TIRES	RAW SUGAR*	COTTONSEED OIL*	MERCHANT PIG IRON	DEPT. OF COM. INDEX OF STOCKS—45 COMMODITIES
	100 = 630,757,000 gals.	100 = 19,742,000 pieces	100 = 77,202 tons	100 = 30,000 tons	100 = 4,364,000 tires	100 = 114,000 tons	100 = 255,400,000 lbs.	100 = 634,950 tons	100 = 132
July 1921	103	100.5	116.4	88.7	95.2	109.0	118.5	109.5	93.0
Aug.	109	99.5	119.7	85.0	89.2	77.0	123.0	109.5	89.5
Sept.	108	99.5	112.1	90.4	90.2	87.0	129.5	100.0	92.0
Oct.	109	96.4	105.1	100.8	76.6	116.0	60.0	94.0	103.0
Nov.	102	95.9	91.7	76.7	81.2	69.0	71.0	82.0	100.0
Dec.	102	95.2	86.8	77.1	89.6	96.0	84.0	80.0	104.0
Jan. 1922	103	98.5	78.5	79.8	84.7	95.0	92.0	86.0	104.0
Feb.	110	99.0	85.1	88.5	95.6	88.0	84.0	90.5	113.0
Mar.	110	100.7	83.1	92.7	107.5	136.0	82.0	86.0	114.5
Apr.	110	95.4	78.1	93.9	118.8	186.0	84.0	84.5	104.0
May	110	101.5	67.0	82.9	125.2	140.0	89.0	70.0	94.0
June	111	101.6	52.3	82.6	126.6	105.0	82.0	52.5	95.5
July	114	98.3	38.3	77.9	115.5	107.0	84.0	49.0	88.0
Aug.	123	97.4	37.1	70.5	110.8	151.0	87.5	38.0	76.5
Sept.	133	91.5	28.0	66.3	106.1	132.0	89.0	25.0	81.0
Oct.	146	90.2	21.4	62.7	103.7	122.0	37.0	23.8	97.0
Nov.	161	87.7	23.4	65.8	107.3	70.0	35.0	25.0	92.0
Dec.	160	85.9	25.3	65.4	113.8	55.0	42.0	29.8	95.0
Jan. 1923	156	85.3	23.6	64.0	105.4	55.0	52.0	35.8	95.5
Feb.	156	84.0	21.5	76.7	107.6	76.0	60.0	43.0	98.5
Mar.	154	82.6	14.1	77.3	119.7	86.0	64.5	44.0	100.0
Apr.	162	81.6	13.0	67.2	129.9	168.0	67.0	38.0	93.0
May	164	81.4	11.6	62.9	139.3	147.0	69.0	41.7	79.0
June	173	82.1	16.9	60.5	159.6	97.0	71.0	53.6	78.0
July	174	82.8	22.2	65.0	161.4	97.0	76.0	72.7	77.5
Aug.	185	83.6	27.5	74.0	148.0	96.2	74.0	97.5	79.5
Sept.	199	84.3	31.4	85.5	138.5	81.8	57.4	111.0	86.5
Oct.	206	84.2	29.6	82.2	123.2	130.4	28.0	121.7	96.0
Nov.	211	85.4	33.4	82.4	111.7	102.8	43.0	131.0	100.0
Dec.	202	85.8	40.3	80.0	107.5	89.8	43.3	141.0	102.0
Jan. 1924	186	87.0	47.3	78.8	99.0	79.0	52.5	145.0	100.0
Feb.	159	79.5	52.7	94.6	111.0	54.5	....	144.5	.
Mar	...	....	48.0	.....	.....	.....	.....	.....	.....

* Adjusted for seasonal variation.

Iron and Steel Production

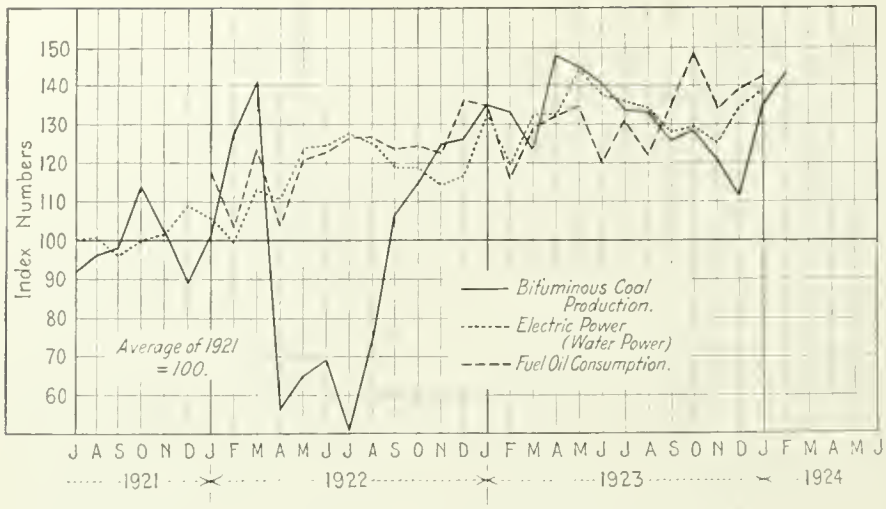
Production. During February the average daily production of pig iron rose 9 per cent. The index (Fig. 3), which was 219 on January 31, reached 238.5 on February 29. This is corrected for normal seasonal change. The index of the average daily production of steel ingots during February rose 13.5 per cent from the January 31 level of 215, to 244 on February 29. (Fig. 3).

Unfilled Orders. Unfilled orders of the United States Steel Corporation increased slightly during February, while shipments for the same month were heavy. The index rose from 87.5 on January 31, to 88.5 February 29, an increase of 1 per cent.

Unfilled orders for 108 merchant pig iron furnaces as of January 31 were 1,296,930 tons, an increase of 15 per cent over December 31. At the present time, however, it seems that unfilled orders of these furnaces are likely to decline during February, because of the generally quiet tone of the pig iron market.

Prices. The Iron Age composite steel price on March 13 was 2.746 cents per lb., the lowest price since last April. The composite iron price from the same source is $22.86 per ton, which is 2 cents below the price of a month ago.

Conclusion. The steel market has reacted to the decided drop in contemplated construction of new buildings, and it seems that *both the iron and steel industries are producing more than the*



Sources, Department of Interior; Bureau of Mines; United States Geological Survey

FIG. 5 FUEL AND POWER PRODUCTION

Bituminous coal and electric power corrected for seasonal variation.

present demand warrants in spite of good orders from the railways. In view of the present outlook in these two industries no price rise is probable in the near future.

Production in Important Industries

Copper. Copper production during January increased 2.5 per cent and the index (Fig. 4) is now higher than at any time during the past three years. This industry is undoubtedly in an unfavorable situation on account of heavy production and no permanent improvement can be expected until either (1) production is curtailed, or (2) a considerable gain in demand occurs. At present an increase in export demand appears to be the chief hope.

Paper. Paper production during January increased 12 per cent above the December level of output, but the outlook in this industry is favorable.

Wool. During January the consumption of wool rose 9 per cent above the December level. The outlook in this industry continues to show moderate improvement.

Cotton. The consumption of cotton during February, after allowing for seasonal variation, was 8½ per cent below that of the previous month. This index reflects the situation in the cotton manufacturing industry, which is suffering from high raw material costs and low finished product prices.

Fuel and Power

Coal. The index of production of bituminous coal rose during February (Fig. 5). The index on February 29 stood at 143.5, compared with 135 on January 31. (The average for 1921=100). This index is adjusted for the normal seasonal movement. At most points coal is in ample supply and the market is weak.

Fuel Oil. During January fuel oil consumption increased 2.5 per cent over the December consumption. The index for January is higher than at any time except October 1923. Fuel oil prices, however, have been strong.

Hydroelectric Power. The production of hydroelectric power during January was 3.5 per cent greater than during December. This index is also near the high point.

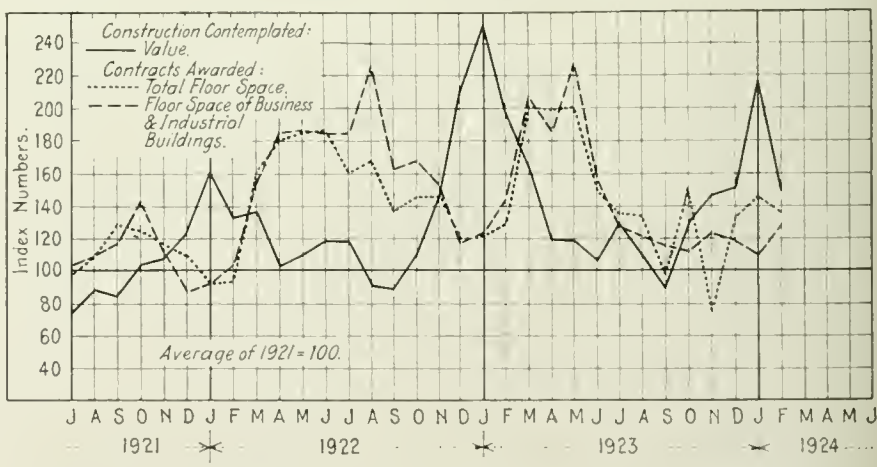
Conclusion. These indexes all reflect the increased activity in industry. Evidently *industrial power is being generated at near peak levels and this agrees with the reports of increasing output in basic industries.*

Building Activity in February

Contemplated Construction. According to the data furnished by the F. W. Dodge Company, contemplated construction during February decreased 25 per cent from the January level, and was also *21 per cent below February 1923.*

Contracts Awarded. The index of total floor space in contracts awarded also declined during February, falling from the January level of 144.5 to 135.2 (Fig. 6), a decline of 6.5 per cent. The figure is 5 per cent greater than in February 1923. The index for business and industrial building, however, rose 17 per cent, causing an abrupt change in the trend of this index. With the exception of a very minor rise last November, it has been declining since last May.

Conclusion. The February building statistics are decidedly disappointing to optimists. The abrupt decline in contemplated construction suggests an early termination of the spring building activity, and this, together with the decline in contracts awarded, now makes it seem *probable that building will not reach so high a peak in 1924 as it did in 1923.* The chief gains during February came in New York.



Source, F. W. Dodge Company

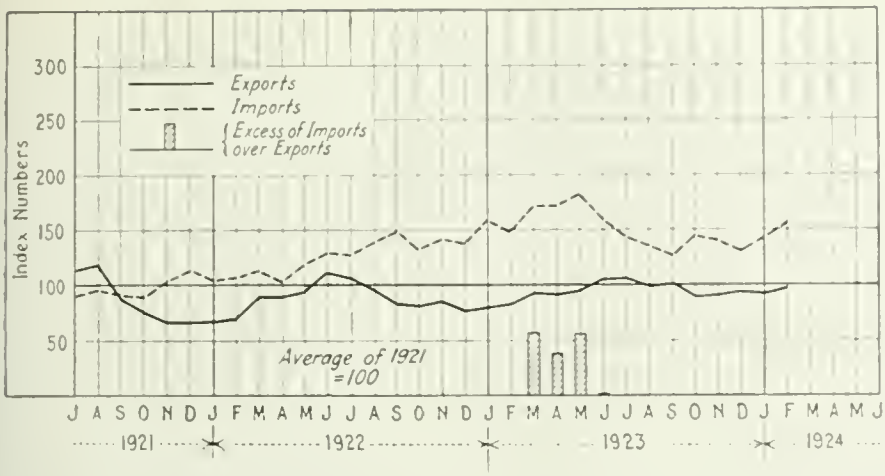
FIG. 6 BUILDING CONSTRUCTION AND FLOOR SPACE IN CONTRACTS AWARDED

Construction contemplated corrected for seasonal variation.

Trend of Trade and Finance

Prices Uncertain in Trend: Trade Continues Good

Exports during February totaled $367,000,000, the smallest since August 1923. This decline from the January figure of $394,000,000 has been chiefly due to shrinkage in cotton shipments. The adjusted index of exports for Feb-



Source, U. S. Department of Commerce

FIG. 7 FOREIGN TRADE OF THE UNITED STATES
Corrected for seasonal variation.

ruary stands at 95.2, compared with 93.3 for January. See Fig. 7. (The adjustment allows for seasonal variation and leap year).

Imports during February amounted to $335,000,000, the largest February figure since 1920, and the largest total for any month since May 1923. After adjustment for seasonal variation, the index of imports for February is 156.6, as against 141.6 for January.

Conclusion. At this time it appears that the general trend of our foreign trade is going to run as it did last year, with a fairly close approximation of imports to exports, and an import surplus, at least temporarily.

New York Stock Exchange

As indicated in Fig. 8, the average price of 50 stocks fell off between the middle of February and the middle of March, declining from $6.37 to $6.09. The low price came on March 3, when the average was $5.07.

The stock market has shown decided speculative inactivity with an extraordinarily low volume. The third week of March prices were rising slightly with a gradual increasing volume, but the market was extremely irregular.

The stock market has been giving a true forecast. The decline in February was a readjustment in view of the less favorable business outlook. The dullness since that time has reflected the uncertainty which exists concerning the future. The failure of the market to decline in the face of severe bear attacks, however, shows that no serious future break is to be anticipated.

Bank Debits and Postal Receipts

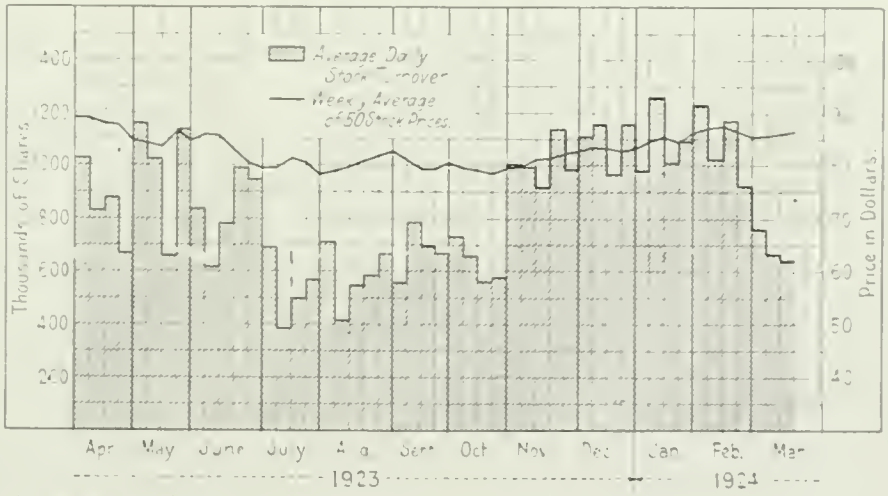
Bank Debits. February debits to individual accounts are usually small compared to other months. (See Fig. 9). Adjustment of February data for normal seasonal variation shows a loss from January slightly less than that indicated by the average February experience for the past five years. The February adjusted index, therefore, rose to 122.2, a gain of 1 per cent over January.

Postal Receipts. The unadjusted index of postal receipts for 50 selected cities, during February fell 3 per cent from the January figure. This decline, however, was only a trifle greater than the normal seasonal change during February. Elimination of the usual seasonal movement shows a February index of 123.4, compared with the January figure of 124.2—an insignificant decline.

Conclusion. The behavior of these two valuable indexes in February *indicates a slight gain in the total volume of trade and continued stability in general business conditions.*

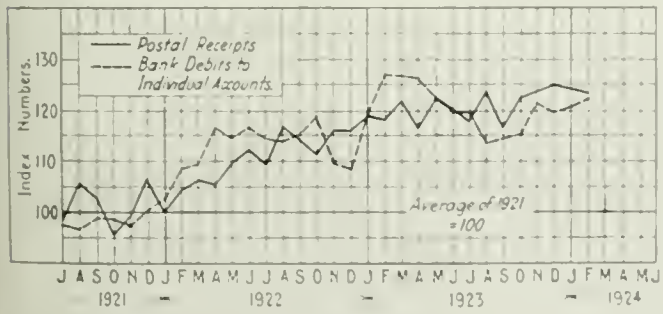
Retail Trade

Mail Order Sales. February sales of Sears-Roebuck and Montgomery Ward


Average Daily Stock Turnover
Week's Average of 50 Stock Prices
Thousands of Shares
Price in Dollars
Apr May June July Aug Sept Oct Nov Dec Jan Feb Mar
1923
1924

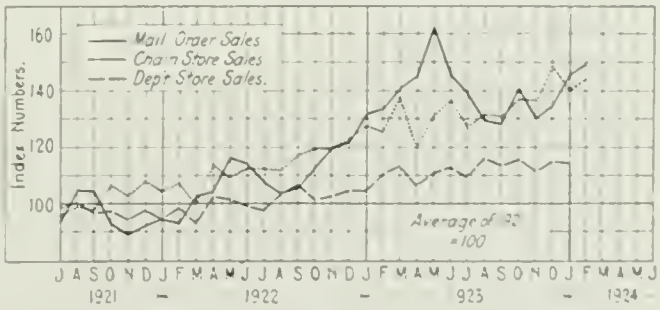
Source, New York Times

FIG. 8 STOCK TURNOVER AND PRICES ON NEW YORK STOCK EXCHANGE


Postal Receipts
Bank Debits to Individual Accounts
Index Numbers
Average of 1921 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

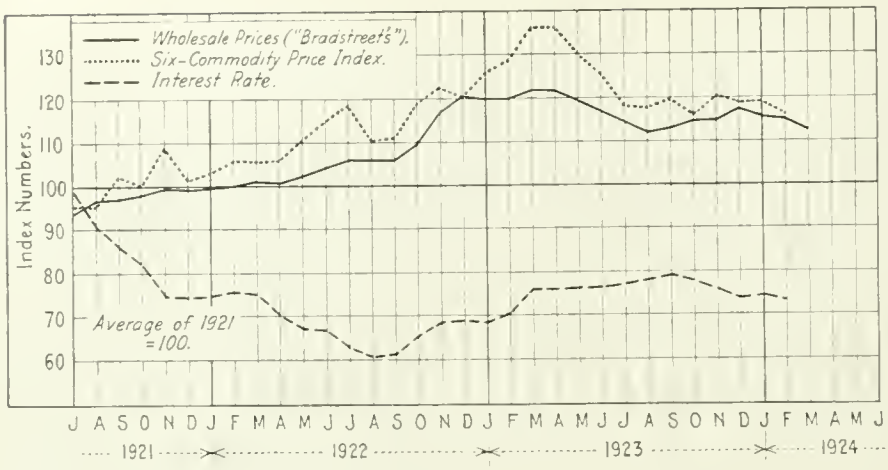
Sources, Federal Reserve Board; Post Office Dep't.

FIG. 9 BANK DEBITS AND POSTAL RECEIPTS
Both curves corrected for seasonal variation.


Mail Order Sales
Chain Store Sales
Dept Store Sales.
Index Numbers
Average of 32 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Commercial and Financial Chronicle; Federal Reserve Board

FIG. 10 SALES OF MAIL ORDER, CHAIN AND DEPARTMENT STORES
Two mail order houses; 4 chain stores; 3 department stores. Corrected for seasonal variation.


Wholesale Prices ("Bradstreet's").
Six-Commodity Price Index.
Interest Rate.
Index Numbers.
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Commercial and Financial Chronicle, Federal Reserve Board

FIG. 11 WHOLESALE PRICES AND INTEREST RATE

Interest rate is the monthly average, corrected for seasonal variation.

totaled $30,467,000, as compared with $30,508,000 in January. Adjustment for normal seasonal variation gives a February index of 149.5, a gain of about 2½ per cent over January. (Fig. 10).

Chain Store Sales. The adjusted index of the February sales of four large chain store systems is 144.0, as against 140.0 for January, a gain of nearly 3 per cent.

Department Store Sales. After adjustment, the January index of department store sales—the latest available—stands at 114.3, compared with 115.0 for December.

Conclusion. It is evident that *retail trade is continuing at a high level.*

The adjusted indexes for February (which allow for normal seasonal variation and for the extra day due to leap year) show a *net gain for the month of about 3 per cent in chain store and mail order sales.* Evidently both the buying power and the will to spend of consumers is sufficient to support good business at existing prices, but indications are not lacking that at present higher prices would curtail buying.

Prices and Interest Rate

Prices. On the first of March both Bradstreet's and Dun's price indexes registered a decline, Bradstreet's falling 2.2. (See Fig. 11). The decline in cotton was the chief factor. The Bureau's special six-commodity index averaged for February 116.3 as against 119 in January. (The average for 1921 = 100).

Interest Rate. The interest rate on best commercial paper as quoted in the market remained unchanged during February, but after eliminating seasonal variation, the adjusted index declined from 74.5 to 73.3. The adjusted index of the interest rate on prime 60-90 day commercial paper rose from 69.7 in January 1923 to 79.2 in September. Since then it has been steadily declining, with a slight upturn in December.

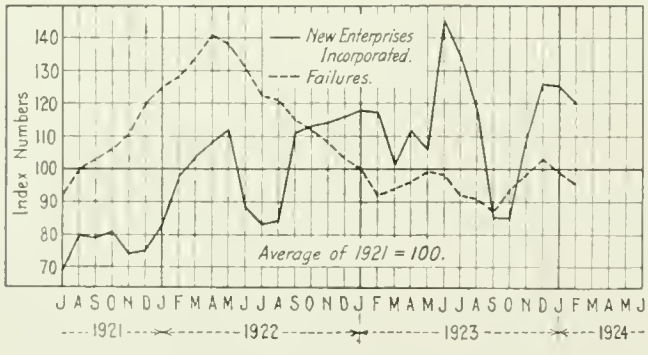
Conclusion. The trend of prices is now uncertain. The rise which took place between August and January was followed by fairly stable prices, but in February the decline, though small, was clear. This reflects the prevailing uncertainty in business. As to interest rates, the firmness of January has not been long lived and *the tendency is now for a continuation of easy money.*

Business Failures and New Enterprises

Business Failures. Failures decreased in number during February as is usual in that short month, but the decline was smaller than last year. This was due in part to the larger number of days in February this year. Allowing for this factor and for the normal seasonal variation, there was a slight gain in the index. (See Fig. 12).

New Enterprises. The capitalization of new enterprises incorporated in February was less than usual, but the decrease was not so great as normally occurs in the month, with the result that the February index rose. (The fact that the curve in Fig. 11 is a three months' average prevents this rise from being reflected therein).

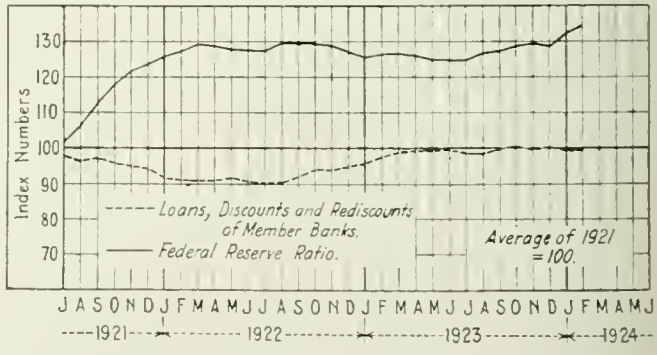
Conclusion. An examination of the business birthrate and deathrate shows a mixed condition. The failure data indicate no improvement. New enterprises lead to slightly favorable conclusions, but the change is not marked enough to offset the unfavorable trend shown in the last three months. *The net conclusion is one of uncertainty. Business enterprise is not expanding much and failures continue abnormally high—though the excess over normal is not great.*


New Enterprises Incorporated.
Failures.
Index Numbers
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Dun's Review; N. Y. Journal of Commerce

FIG. 12 BUSINESS FAILURES AND NEW ENTERPRISES

Adjusted for seasonal variation; curves plotted as 3 months' moving average.


Index Numbers
Loans, Discounts and Rediscounts of Member Banks.
Federal Reserve Ratio.
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Source, Federal Reserve Board

FIG. 13 BANK CREDIT AND FEDERAL RESERVE RATIO

Federal reserve ratio is ratio of total reserves to note and deposit liabilities and has been corrected for seasonal variation.

Bank Credit

Loans and Discounts. Total loans and discounts of the 759 reporting member banks of the federal reserve system were $11,874,221,000 on February 27. These figures show virtually no change from January, the index number for both months being 99.6. (See Fig. 13).

Federal Reserve Ratio. After eliminating the normal month-to-month variation, the February index of the ratio of

reserves to deposit and federal reserve note liabilities combined, rose to 134.7 from the January position of 132.5.

Conclusion. It is evident that *member banks are extending a large amount of credit without the necessity of recourse to the reserve banks.* The volume of loans and discounts has changed little during the last four or five months but is being maintained at a level about 3 per cent over that of January 1923. On the other hand, the "reserve ratio" has shown an upward trend since July 1923, and is now at the highest point reached in several years. These facts support the conclusion that: (1) there is no tendency to inflation yet apparent; and that, (2) while business activity is well maintained, there is no such volume as to require unusual extension of credit.

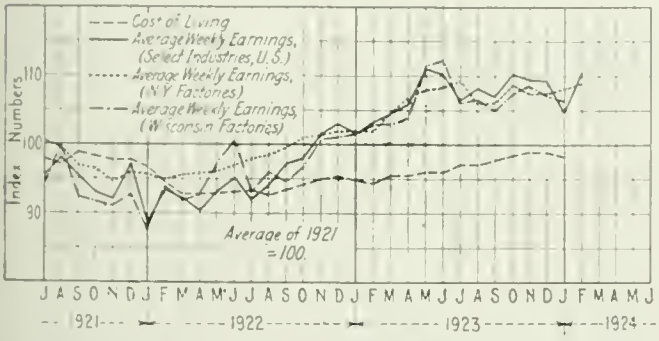
Wage and Employment Situation

Slight Fall in Employment: Increase in Earnings

Earnings and Cost of Living

The trend of average weekly earnings and the cost of living is shown in Fig. 14.

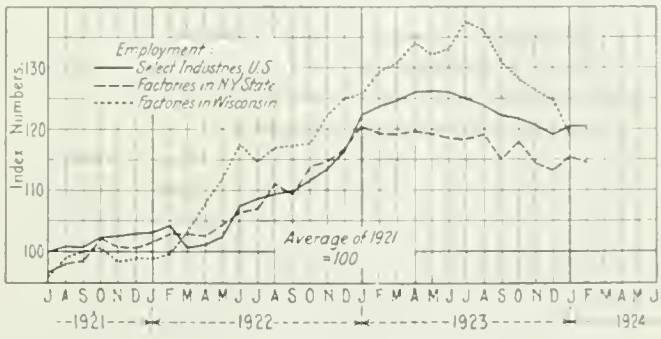
New York State. The seasonally adjusted index increased slightly in February. The labor situation is uncertain at present and next month's reports, which should tell the story, will be critical. Increased labor purchasing power is indicated.


Cost of Living
Average Weekly Earnings, (Select Industries, U.S.)
Average Weekly Earnings, (N.Y. Factories)
Average Weekly Earnings, (Wisconsin Factories)
Index Numbers
110
100
90
Average of 1921 =100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, U. S. Bureau of Labor Statistics; N. Y. State Dep't of Labor; Industrial Commission of Wisconsin; National Industrial Conference Board

FIG. 14 WAGES AND COST OF LIVING

New York and Wisconsin factories curves corrected for seasonal variation.


Employment
Select Industries, U.S
Factories in N.Y. State
Factories in Wisconsin
Index Numbers
130
120
110
100
Average of 1921 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, U. S. Bureau of Labor Statistics; N. Y. State Dep't of Labor; Industrial Commission of Wisconsin

FIG. 15 THE TREND OF EMPLOYMENT

Corrected for seasonal variation.

ary for the third consecutive month. It is now as high as at any month during the past three years with the exception of July 1923. February data from Illinois support the New York trend. In Illinois employment increased, and weekly earnings rose from $27.27 in January to $28.36 in February.

Wisconsin. In January the season-corrected index of earnings dropped from 107.2 to 106.4. (The average during 1921 = 100).

Selected Industries in the United States. In February the index (unadjusted for seasonal variation) increased from 104.9 to 110.6—the average for 1921 being 100. This gain is largely seasonal, and follows a drop of 4.5 in the index in January.

Cost of Living. The cost of living, as reported by the National Industrial Conference Board, was practically unchanged in January, there being a slight decrease of about 0.2 per cent.

Conclusion. The cost of living, Fig. 14, and Wisconsin earnings, decreased in January. United States and New York factory earnings advanced in February. The labor situation is uncertain at present and next month's reports, which should tell the story, will be critical. Increased labor purchasing power is indicated.

The Employment Trend

New York State. In February the index of employment, Fig. 15, after eliminating seasonal variation, declined from 115.4 to 114.6. (The average for 1921= 100). Actually there was an increase of about one per cent. However this is less than the normal February recovery from January dullness. The gain in New York City was greater than in the up-state section.

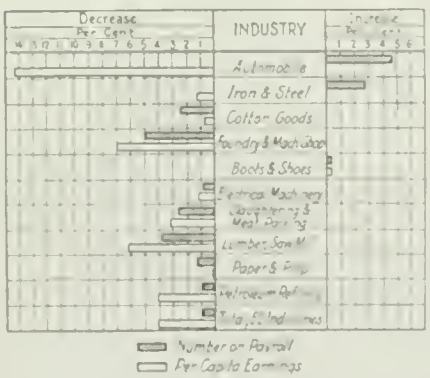


FIG. 16 TREND OF EMPLOYMENT AND EARNINGS, JANUARY 1924

Wisconsin. The seasonally adjusted index declined again in January. The decline has been continuous since July 1923. The index is now but slightly higher than that of October 1922. But it is well above the average for 1921, which was 100.

United States. In the United States as a whole, employment showed merely the usual seasonal gain, leaving the index unchanged.

Conclusion. Employment in February was practically unchanged from January, but was slightly lower than last year.

Employment and Earnings in Selected Industries

Fig. 16 shows the course of employment and per capita earnings during January in 10 of the leading industries of the United States. For most of them there was a pronounced decline.

The average drop in employment for the total of 52 industries was only 0.9 per cent, which is less than the normal decline in January.

The average decrease in per capita earnings in the total of 52 industries was 4.1 in January. Indications are that in February this decline in earnings was checked.

Immigration and Emigration

As usual, at this season, the number of immigrants admitted to the United States fell off markedly during December and January. The actual figures follow:

1923	*Immigrants*	*Emigrants*	*Net Gain*
Nov.	92,782	6,925	85,857
Dec.	55,794	9,480	46,314
1924			
Jan.	33,878	5,723	28,155

PORT NEWARK

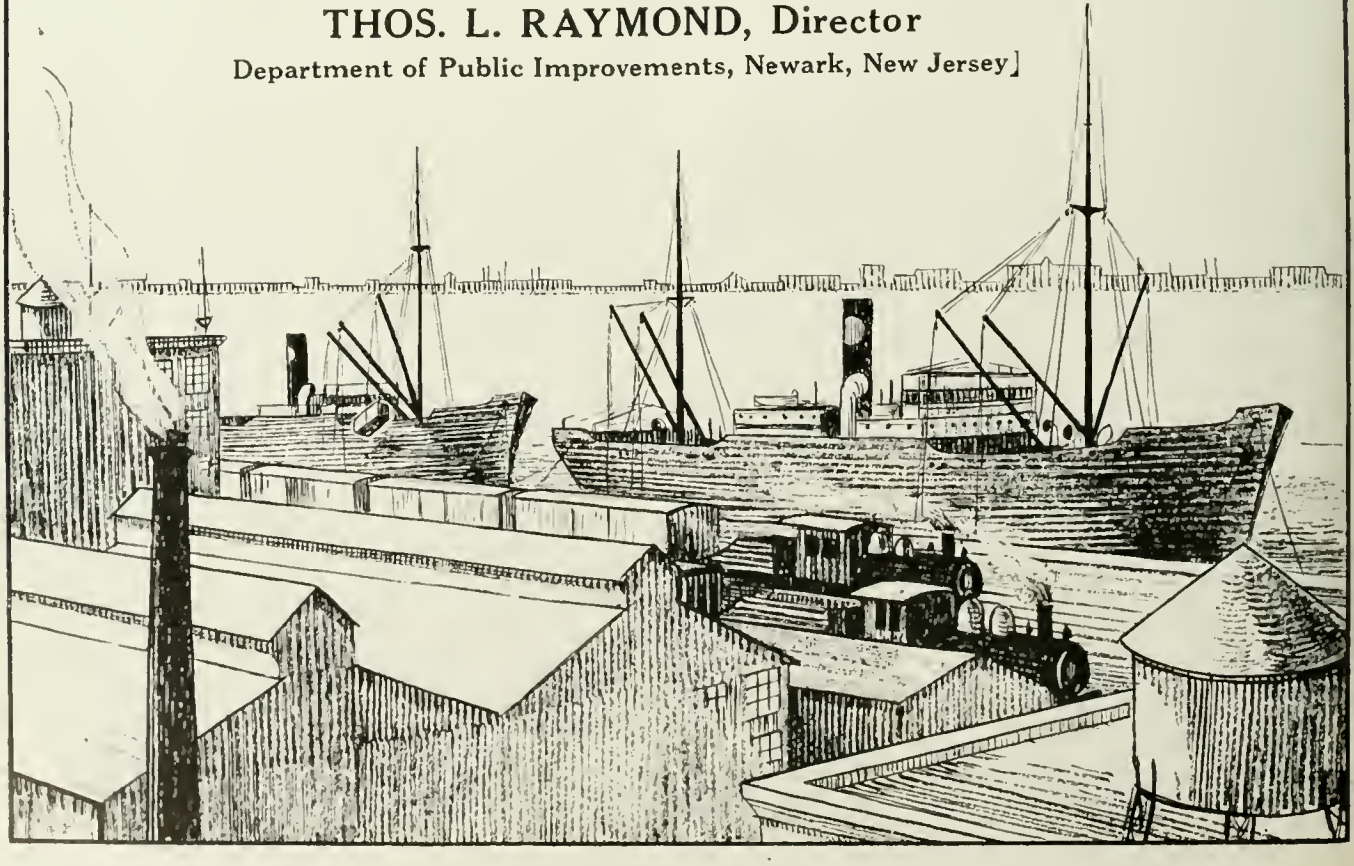
Makes Possible Quicker, Cheaper Distribution to America's Greatest Markets

A circle drawn around Port Newark, with a radius long enough to include Boston, would encompass practically every great city of the East with a population within its circumference of about forty million people.

With a warehouse or factory at Port Newark you could serve this tremendous market—40% of the nation's population—more economically and more speedily than from any other location in the country. You could actually make over-night motor truck shipments to the great cities of New England, and to Philadelphia and the middle Atlantic Seaboard cities, as far as Baltimore. You could make all-water shipments direct from Port Newark to Buffalo and the Great Lake ports, via the New York State Barge Canal. You would have direct access to seven trunk line railroads for freight shipments to the inland cities. In addition to these facilities you would enjoy the regular steamer service of the Transmarine Lines between Port Newark and the Gulf and Pacific Coast ports.

In short, location at Port Newark has every advantage of location within the limits of metropolitan New York with the additional advantage that land values are surprisingly lower. Choice sites for factories or warehouses are now available. For full details write for "Port Newark," the free book that tells all about this remarkable development and its surrounding territory.

THOS. L. RAYMOND, Director
Department of Public Improvements, Newark, New Jersey

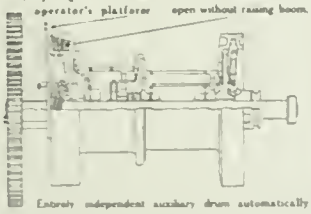


Why Industrials Excel

5 AUTOMATIC DOUBLE DRUMS

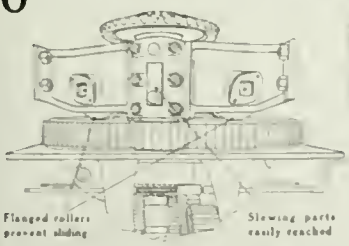
Lever regulates tension in opening line from the operator's platform

Speedy bucket work due to the clutch lifting bucket open without raising boom.



Entirely independent auxiliary drum automatically controls bucket opening line without lever or power from other drum and gives two lines for erection or dragline service.

6 POSITIVE SLEWING CONTROL



Flanged rollers prevent sliding

Slewing parts easily reached

Extra heavy gearing with external rack bolted rigidly to car body and efficient brake give absolute slewing control, allowing loads to be handled on grades and uneven tracks without danger of sudden rotation with its possible disastrous results.

Your competitors' production costs—

WE KNOW of plants where the yard, shipping and receiving payroll is so high that total production cost almost equals their competitor's selling prices. These plants are not equipped with INDUSTRIAL locomotive cranes. We have on file thousands of installation records, showing a decrease in material-handling costs to as low as one-tenth of the cost before the installation of INDUSTRIAL cranes.

Whether your needs be for a baby 5-ton or for a monster 200-ton, there is an INDUSTRIAL that will solve your material-handling problems. Equipped with a clamshell bucket, an electro-magnet, a hook and block, pile driver leads or a shovel dipper arm, they are available for every problem. Steam, electric or gasoline power, operating on rails, crawling tractor or traction wheels, they fit every purpose. As an executive it will pay you to investigate.

There are 17 standard types of INDUSTRIAL cranes with a capacity range from 5 to 200 tons. All are fully illustrated and described in our Golden Anniversary Catalog, a copy of which will be forwarded to you promptly upon request.

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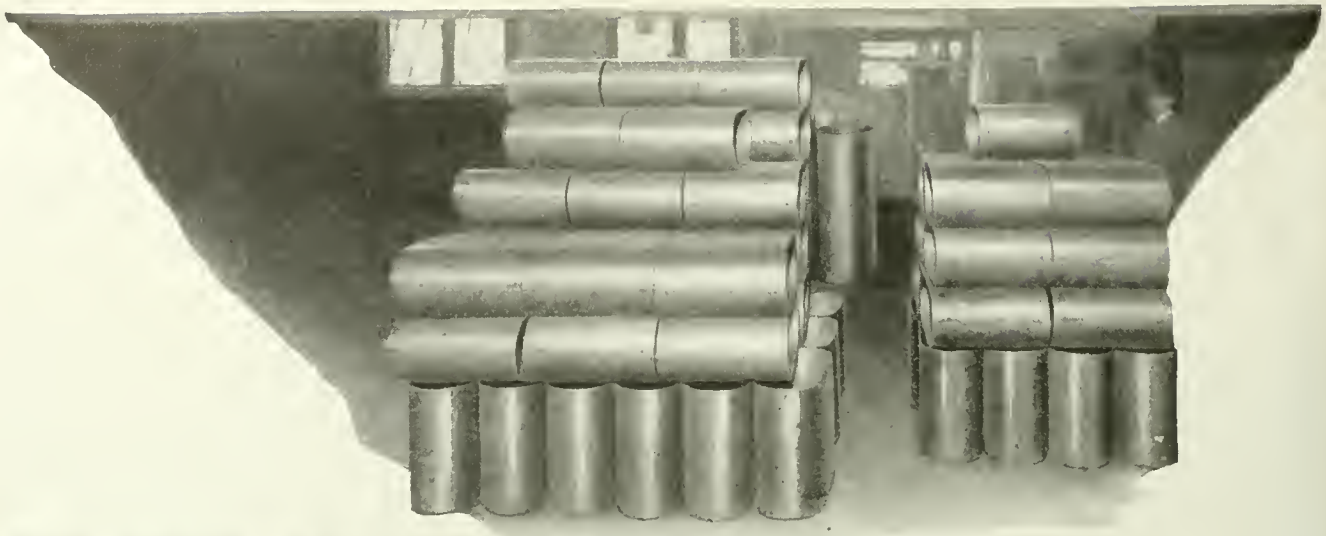
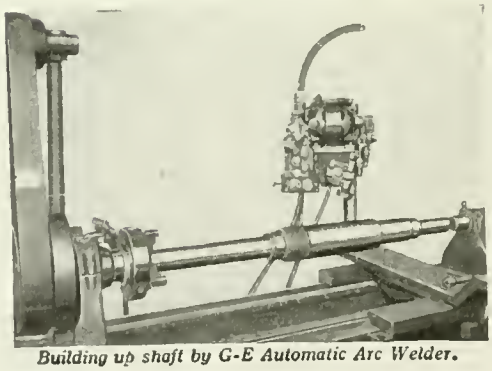
BAY CITY - MICHIGAN

Locomotive Cranes, 5 to 200 Tons -- Transfer, Pillar & Gantry Cranes
Railway Pile Drivers -- Combination Crane Pile Drivers -- Transfer Tables
Portable Rail Saws -- Grab Buckets -- Magnets -- Steam Pile Hammers

INDUSTRIAL LOCOMOTIVE CRANES



Straight seam welding of tanks by G-E Automatic Arc Welder.



Building up shaft by G-E Automatic Arc Welder.

Automatic Arc Welding

The above picture shows 50 tanks welded by a G-E Automatic Arc Welder in a half day, as compared to 21 tanks welded by the hand method in a full day. The metal welded is 1/8" thick by 24" long.

Through this automatic application of the electric arc, a steadiness of the electrical conditions in the arc is obtained and maintained, resulting in a uniform and high quality of weld—and higher speed. Higher welding speeds produce lower welding costs.

The principal field for the G-E Automatic Arc Welder is the production, by welding, of duplicate objects in considerable quantities.

Its greatest use is for straight line seam, which is the simplest form of weld—but it also does efficient welding of circular seams, and in building up processes on metal.

G-E welding engineers will cooperate with you in making suitable applications of the Automatic Arc Welder to processes of production in your plant. Ask them.

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MANAGEMENT
AND
ADMINISTRATION

VOLUME VII APRIL, 1924 NUMBER 4

Maintaining A Profit With Reduced Prices

How We Increased Capacity 50 Per Cent and Lowered Unit Costs

By E. A. MUNSCHAUER

President, Heinz and Munschauer

IN the 58 years that we have been making refrigerators we have given constant study to the problems of reducing costs and increasing production. We have every reason to believe that we were as efficient as any of our competitors. Then a few years ago we embarked on an advertising campaign which so increased the demand for our product that increased production became imperative. But because the time was not ripe we were disinclined to lay out much money for additional equipment. At the same time we felt acutely the need of reducing our costs, for a somewhat peculiar reason.

The refrigerator business is highly seasonal. The entire year's production is sold in a single season of from 3 to 4 months. If that selling season were a good one in which we were able to move our stock at regular prices we made money. If, as occasionally happened, the season was a poor one, we had to move the stock anyway. That was done by slashing prices almost to cost. In such a year there would be no profits. We determined to find out if costs could not be cut to a point that, even with reduced prices, a profit would result. We knew that if we could increase production without additional men or machinery, costs would come down proportionately.

Methods of Increasing Production

To increase production we did two principal things. We adopted a simple method of controlling production and we installed wage incentives in two departments. As mere incidents to facilitate the flow of work and to prevent delays we bought a few additional trucks, established reservoirs of materials in process between operations, and strengthened our control of raw material stocks.

By these means we reduced the length of a production cycle from 6 days to 4 days. Our production was formerly 60 refrigerators a day. We now have a capacity of 90 a day—an increase of 50 per cent. Since the only addition to our force is a production clerk, it is apparent the labor and overhead expense is around 35 per cent less.

Index Number
658.5 Production Management

We were not at all sure that any possibilities for improvement existed but we were so determined to know, that we had a preliminary study made by a firm of industrial engineers. Their report led us to employ them to supervise the installation of the methods they recommended.

Our Original Conditions

While the plant was an old one it was logically and well laid out for straight-line production. There was but very little overlapping or back-tracking of materials between departments.

Our workmen were mostly skilled and conscientious with records of long and faithful service. The equipment while not the last word in woodworking machinery was well adapted to the needs of the shop. The machines and the departments were in quite good balance, so that there were no bottle necks to impede production. Such minor lack of balance as existed was taken up by the workmen speeding up or dragging out their work at times as conditions arose.

The workers were all paid on a day-work basis which in itself of course does not tend to stimulate them to great effort, but the engineers told us that on the whole our force was conscientious and made a creditable showing compared to other day-work shops.

It has been our practice to lay out the production for a year based on the previous years' sales. Work was released to the shops by lots. Since the sequence of operations and parts had been correctly laid out, the materials came to the various assembly points in proper order and quantity.

Due to the good conditions above enumerated it became apparent that the only way production could be increased was by reducing the idle time of men and machines and by speeding up the operations. To that

end, time studies were made on each machine operation. Machines are usually the bottle necks for they are the inflexible limiting factors of production. If production jams at hand operations extra men can readily be added without a heavy outlay for equipment.

The purpose of the time studies was to determine how long it would take to put the parts required for a 30-doz. lot of an average size of the best selling refrigerators through each machine operation. I might add here that our standard lots range from 25 to 40 doz. refrigerators. The size of the lots was so chosen that the same time would be taken for the standard lot of any type and size.

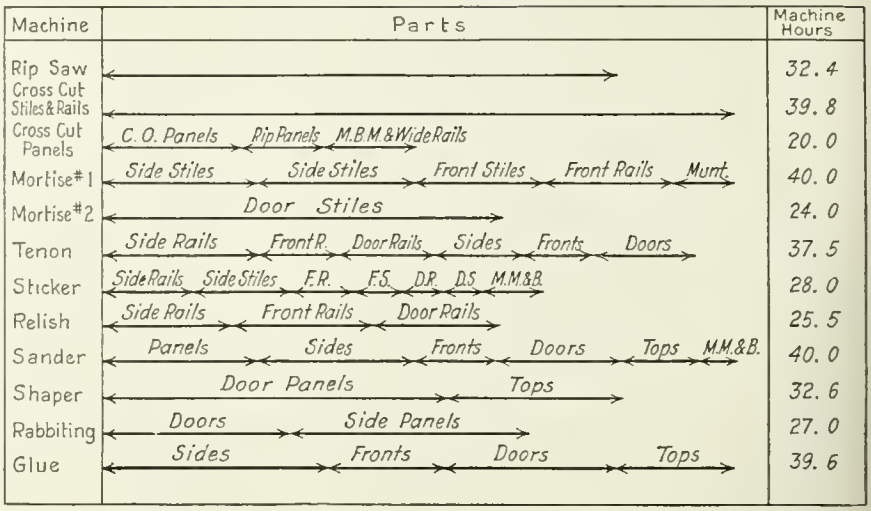


FIG. 1 MACHINE LOAD CHART SHOWING STANDARD HOURS PER MACHINE (AS DEVELOPED FROM TIME STUDY) FOR A 30-DOZ. LOT REFRIGERATOR #312

In Fig. 1, the machine load chart, we listed the machines, the parts made on each, and the total time required by each machine to turn out the parts required for the standard 30-doz. lots. Note that of the 12 machines (or departments) two require a maximum time of 40 hr. Five of them, namely the ripsaw, the crosscut (for stiles and rails), the mortise No. 1, the tenon, the sander, and the glue department required either exactly 40 hr. or close to it. These are the actual operations, to which have already been added 20 per cent for fatigue, personal needs, and unavoidable interruptions, and an arbitrary half-hour for set-up between parts.

In taking the times fair average workers were studied, no attempt being made to spur them on. The only deviation from normal operation was that a plentiful supply of parts was at the machine and correct tools were provided.

Since five of the 12 operations approximated 40 hr., the fact stuck out like a sore thumb that 40 hr. should be the length of the cycle. On a 10-hr. day that gave a four-day cycle, while in actual year-around production the cycle was a trifle more than six days. If this cycle could be made standard and regularly achieved, the capacity of our plant would be increased 50 per cent.

The first thought was to install wage incentives throughout the plant, but there were some objections to that. In the first place we did not care to undertake the expense of making the studies at that time, and secondly, we felt that it might not be well to make too sweeping and complete changes all at once.

The engineers felt that we could retain the day-wage method of payment and still achieve the four-day cycle by means of a proper planning and production control plan. We are a small concern employing only about 90 workmen, so a highly complicated planning system did not appeal to us. The one the engineers devised is so simple that it requires only one additional man, and is nearly automatic in its control. It embodies principles which we believe might prove successful in other small shops having problems at all similar to ours.

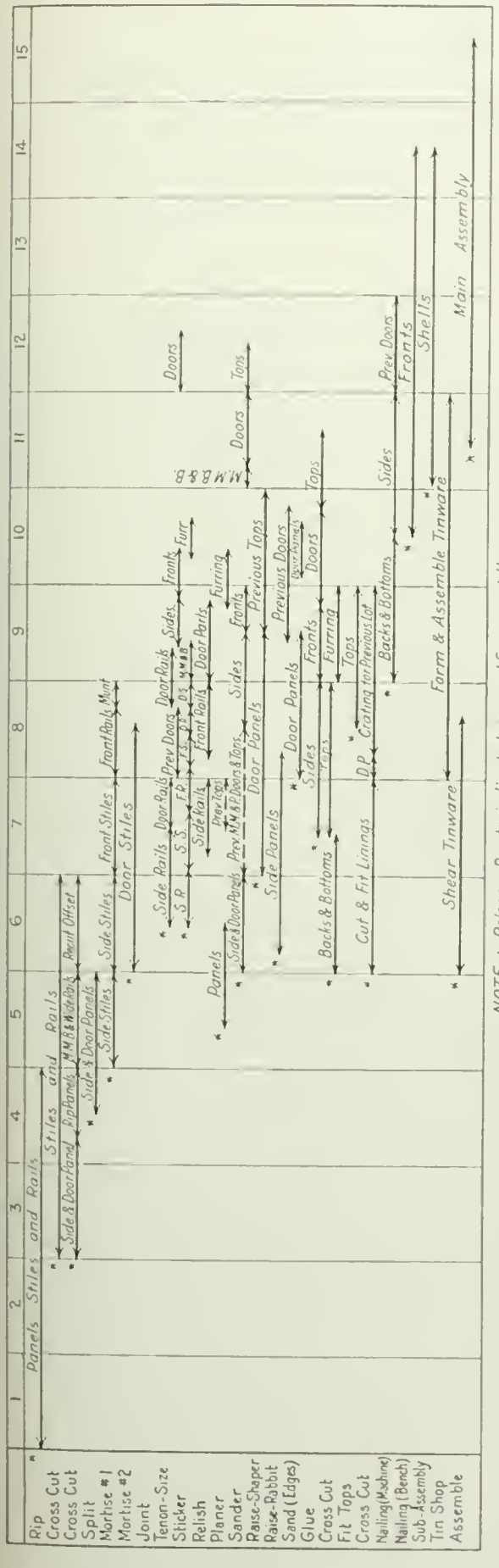
Before devising the planning methods, we had a careful analysis made of the shop and the operations to find out why it was taking 60 hr. to do work that should be done in 40 hr. This was done by taking time and delay studies. Each operation was studied for

DATE _____ CARD No. _____
MAN _____ No. _____
OPERATION _____ No. _____
ORDER No. _____ PART _____
REFER. No. _____ QUANTITY _____

HOURS	MINUTES AFTER THE HOUR										
	6	12	18	24	30	36	42	48	54		
7											
8											
9											
10											
11											
12	N	O	O	N							
1											
2											
3											
4											
5						TOTAL TIME					
ENTERED						RATE					
						LABOR COST					

Box _____ Quantity _____
Part _____
Size _____
Location _____
Completed _____

FIG. 2 TIME CARD FROM WHICH PRODUCTION IS CHECKED



NOTE : Release Points indicated thus ; 1 Space = 1 Hour.

FIG. 3 GRAPHIC SCHEDULE CONTROL SHOWING STANDARD TIME PER PART, SEQUENCE OF PARTS, AND OPERATION RELEASE POINTS FOR A 30-DOZ. LOT OF REFRIGERATOR #312

a total of at least two days, with different workmen performing the operation on different kinds of material at varying times of day.

When these studies were analyzed it was found that there were five principle reasons why the four-day cycle was not being achieved. They were as follows:

1. At times an excessive number of machine set-ups was required to take care of parts that came through in wrong sequence, or small lots which had to be run through in a hurry to make up a shortage.
2. There was no reservoir of parts between operations to take up the slack caused by a breakdown or the absence of a man. If, say, the cross-cut saw man failed to show up, the next operator and the next had no work to proceed on. We were planning too close. In fact, sometimes the parts would have to be taken to the tenon machine as quickly as the cross-cut saw finished them, in order to keep the tenon machine from shutting down. Theoretically such close planning may be beautiful, but in practice it is often expensive.
3. We found that a good deal of delay was caused by breakdowns of machines, tools, and the power transmission equipment.
4. Due to the slow turnover and a truck shortage there was too much rehandling of material. The machine operators piled their finished pieces on a truck by the side of the machine—which was good practice. But sometimes, before the truck was completely loaded and moved to the next operation, it would be urgently needed elsewhere. The material would be removed from the truck and piled on the floor, from where it would ultimately have to be reloaded and moved. Since in so small a shop as ours it seemed best to have the machine operators move the materials, this rehandling at times cut into their productive time seriously and so, of course, hindered production.
5. There was no definite place for material to be stored between operations. The saw man piled, say, stiles on a truck, which might remain for the time at the saw, might be moved to the next operation, or, lacking space at either machine, might be stowed away in any vacant space that was available. When the tenon machine operator was ready for more material, valuable minutes would be wasted while he hunted it up. Sometimes through shear laziness he would get hold of the wrong lot and the proper sequence of parts would be disarranged.

These five faults accounted for the two extra days required for every 30-doz. lot. I do not want to give the impression from this that we were inefficient. On the contrary our engineers said that our shop was 67 per cent efficient, which, they added, was excellent for a day-work shop operating without planned control.

To eliminate these faults we first overhauled our transmission equipment, tools, and machines in order to prevent delays due to breakdowns.

We drew up a graphic schedule control, Fig. 3. This shows the standard time per part, the sequence of parts

on each machine, and the starting point of each part.

Reservoirs of parts amounting to two days' production were set up ahead of each machine to act as cushions to absorb the shocks otherwise caused by production delays. They have also a psychological effect in spurring the workers on to produce in the 4-day cycle. When a man constantly sees plenty of work ahead of him it is difficult for him consciously to soldier. This is the only spur at present used on the machine operators. It has been most effective.

To overcome delays due to rehandling of material, we added approximately 10 per cent additional, which has made it unnecessary to unload and reload a truck.

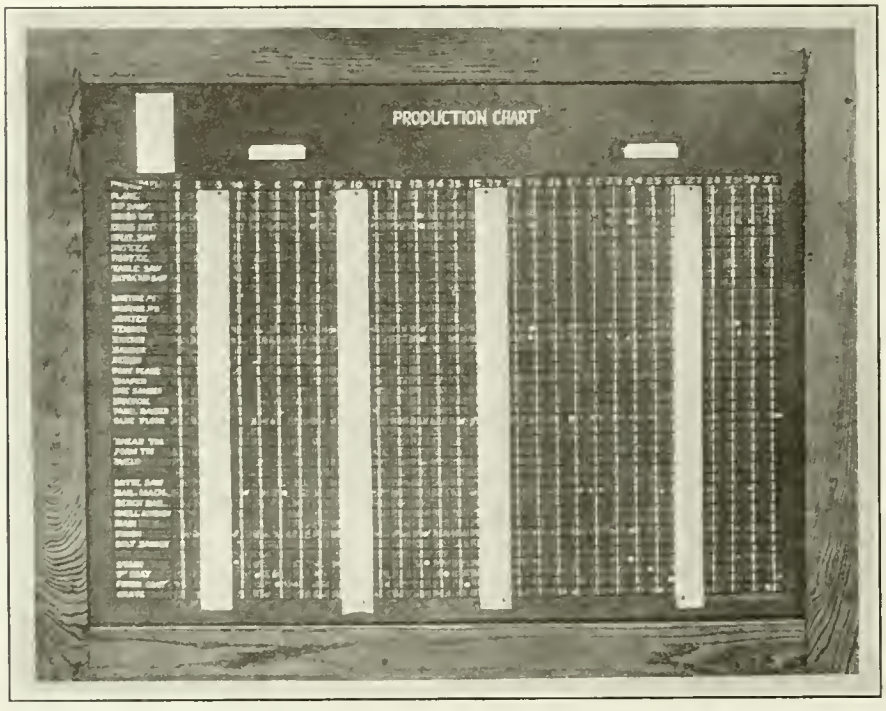


FIG. 4 PRODUCTION CONTROL BOARD

So that there would be no time lost in looking for materials we have provided definite "parking" places between each department which are actually painted on the floor. Now every man knows where his truckload of material must go, and the next operator knows just where to look for it.

When the planning system was first put into effect we used the graphic schedule to follow the first few lots. Their actual progress was marked in red, for comparison with the theoretical schedule. On it we noted the reasons for failure such as "man absent," "man slow," "machine breakdown," and so on. After the new methods got into full swing we discontinued this.

We now use the production control board or chart shown in Fig. 4, on which production is scheduled one or two months ahead. Tacks of a different color for each lot show the scheduled starting time of the lot on each machine. A red tack shows the time it actually started. The planning man each night makes out the time cards (Fig. 2) for each part and each man for the next day. When he gets these cards back he checks the production against the board. If any man falls behind, his foreman is notified and relied upon to speed the workman up.

After this plan had been in operation for a year, we found that only the glue and crating departments were failing to keep up with the four-day cycle. In fact, in the glue department, which is hand work, the force had been doubled in the effort to keep up.

The failure of the crating department was serious, for on its account we could not ship as fast as we could sell.

We again called in our engineers, who made time studies and recommended that we put these departments on piece rates. We agreed to do so.

The technique of time study and rate setting is so generally understood that it seems unnecessary to detail what we did. We used the usual methods and straight piece rates. The results, however, are interesting.

Before putting in piece rates the average number of man hours required per order in the glue department was 175.8. It now averages 81.1. This enables the glue operation to keep up with the 4-day cycle without extra help. The average direct labor cost per dozen has been cut $34.76 which is almost exactly 50 per cent. At the same time the earnings of clampers have increased an average of 23.3 per cent and of the helper 21.5 per cent.

In the crating department, by increasing production, the cost per box for crating has been cut from 38 6/10 cents to 22 8/10 cents, a saving of almost 16 cents.

Little by little we expect to extend the piece-rate method of paying the men to all operations in the shop. When we do we will probably achieve a three-day cycle, which means that we shall have increased our production 100 per cent over the average under former conditions.

The Net Results

In the meantime we have achieved a 50 per cent increase in capacity. In the first year of operation under the new methods, we produced 24,000 boxes as against the usual 18,000—a gain for the year of 33 1/3 per cent. The hitches in the glue and crating departments were largely responsible for the failure to reach the full 50 per cent increase.

Both the preliminary survey and the planning of the new methods which we adopted were the work of Miller, Franklin, Basset and Company, whom we called in to assist us as engineering advisors.

The beauty of this development lies in the fact that the methods were not expensive to install nor to operate. There is no elaborate routine or red tape. Operation is practically automatic and the unit cost of the boxes is steadily being reduced as workmen become familiar with the new system.

Control of Fixed Property Investments

V—Capital Requirements and Control

By J. H. BLISS

Controller, Libby, McNeill & Libby

Index Number
658.14 Financial control
657.421 Fixed property investments

FIXED property investments include investments in plant and equipment properties in which and by which the operations of a business are conducted. Investments in both real and personal property are included. Intangible fixed investments, such as good-will, patents, copyrights, etc., should be excluded and set out in a separate section of the balance sheet. Investments in properties and equipment not used in operations, if of importance, should also be excluded from this division and set out in a separate section in the balance sheet.

If the fundamental relationships which exist between the volume of business done and the fixed property investment are to be clearly set forth in the financial statements, it is necessary to observe carefully the limitations of this fixed property investment section of the balance sheet. It should draw together the accounts representing capital tied up in the properties used in carrying on the business. As stated, it should not include intangible investments nor any sizeable investments in non-operating properties, for both those are of an entirely different character to fixed property investment.

Fixed Property Assets of an Industrial Concern

The assets to be drawn together as fixed property investment in an industrial concern will usually include such as the following:

Land	Tools and Movables
Land Improvements	Furniture and Fixtures
Buildings	Construction in Progress
Leaseholds	Dies, Gages, and Fixtures
Machinery	Patterns
Equipment	Drawings

Reserves for depreciation of investments in such properties should also be included within this group. Reserves for depreciation on properties which are not used in operations and which are carried as investments should be applied to such property investments.

Classification of Fixed Property Assets

A general balance sheet classification of these investments, as indicated in the suggested form of balance sheet presented in the second article of the series [1] is as in Table 1:

This is suggested merely as an average or representative classification of fixed property investments. Obviously when designing the classification of accounts to be used by any individual business, such accounts should be provided as will describe properly the investments of the particular business.

In the various industries, different classifications of fixed property investments will be found. In the case of railroads and public utilities, the classifications to be used are quite generally prescribed by the Interstate commerce Commission or by the state commissions. In many manufacturing industries, trade associations have prepared standardized or uniform classification of accounts, outlining the classification of fixed investments deemed appropriate for those industries.

TABLE 1. A GENERAL BALANCE SHEET CLASSIFICATION OF INVESTMENTS

Fixed Property Investments	Gross Values	Depreciation Reserves	Net Values
Land	$	$	$
Buildings			
Machinery			
Tools and Movables			
Delivery Equipment			
Office Furniture and Fixtures			
Construction in Progress			
Other Fixed Property Investments			
Total Fixed Property Investments	$	$	$

In the preparation of a classification of fixed investment accounts for any particular industry, consideration should be given to a correct and complete designation and definition of the assets to be included in this group of investments, and secondly to the laying out of such accounts as will fit the investments and correctly describe them.

There is no matter of greater importance to an industrial concern than the determination of the policies governing its expenditures for fixed property investments. This policy should rank in importance with other fundamental policies for the conduct of the business, such as standards of quality of product, manner of distribution of products, employees relations, etc., for the reason that the effects of a wise or unwise policy for the handling of these expenditures are so permanent and so far-reaching. It matters not whether

[1] See MANAGEMENT AND ADMINISTRATION for January 1921, p. 25.

a business is a small institution or a large organization, certain sound fundamental principles must be observed. In small businesses, these will likely be evidenced not in the form of written, well-defined policies, but rather with the close contact of the management to the business, in personal conservatism in controlling such expenditures. The larger an organization, the more necessary it becomes to have a well-defined policy for the control of its fixed property expenditures.

When a business makes expenditures for added fixed property investments, it inevitably incurs an added burden of expense in the form of depreciation, insurance, taxes, and protection, and an added financial burden in the form of interest or dividends which should be earned on the increased capital invested. From the point of view of a conservative business and financial policy, only those added fixed investments are justifiable which are necessary to handle increased physical volume and which will produce added net earning power, over and above the increased expenses, sufficient to pay a return on the investment. Further, consideration should be given to the permanence of the added volume which it is expected will be developed and the savings in expenses which it is hoped will be realized. An expansion of physical property investments to care for a temporary volume increase would be unwise. In the same way, added fixed investments for the purpose of realizing savings in expenses will be advantageous only if those savings in expenses are to be permanent.

It should be borne in mind that money expended for additional fixed property investments not only ties up capital permanently, but, as just suggested, places upon the business fixed expense burdens and fixed financial burdens. The advantages which are to be realized out of a conservative policy are therefore inestimable, and by the same token the burdens of an unwise policy are inescapable. Unwise expenditures for materials or goods or marketable securities can be liquidated and the capital released, but unwise expenditures in fixed investments are seldom possible of liquidation.

Importance of Wise Investment Policy

One needs but to review the financial statistics of representative concerns for the past few years to be impressed with the seriousness and importance of these facts. During the war years and immediately thereafter, there was a tremendous expansion in all lines of industry. It was a period of intense industrial activity. It was a period of expansion, of inflation in values, and of artificial prosperity. Prices advanced to two and three times their pre-war levels. The amount of business done by representative concerns, measured in money volume, likewise increased to two or three times normal proportions. The physical volume of business, however, did not increase in any such proportion. Many concerns undoubtedly had substantial increase in physical volume but with a reaction of recent years, have lost physical volume and may be operating at or below pre-war volume standards.

During this period of expansion, great sums of capital were tied up permanently in added facilities. In a measure, they were necessary to handle the increased volume of the war years, but in a greater measure these investments were based on an expansion in values. With values now so much lower and physical volume smaller, many industries are confronted with abnormal fixed expenses and fixed financial burdens. These increased fixed burdens might be carried when prices were at their height, but with both prices and volume reduced, they become a serious handicap.

As a consequence of an unwise policy in regard to fixed property investments, many industries now have productive facilities capable of volume far in excess of the present or probable future requirements. This means that many concerns are afflicted with unduly heavy expense burdens and must therefore exert every effort to obtain the physical volume of business necessary to absorb and carry their fixed expense burdens.

Definition of Additions, Betterments, and Replacements

In the formulation of policies and accounting instructions controlling the handling of fixed property investments, an essential element is a clean-cut and proper definition of additions, betterments, and replacements. The following definition of these terms is used by the Interstate Commerce Commission in the classification of accounts for telephone and telegraph companies.

Additions:

Additions are structures, facilities, and other properties added to those in service at the time of addition, and not taking the place of any of like purpose previously held by the company. The cost of such additions should be charged to the proper plant and equipment accounts.

Betterments:

Betterments are physical changes in structures, facilities, or equipment, which have as their primary end or result the making of the properties affected more useful or of greater capacity than they were at the time of their installation or acquisition. Of the changes incident to betterments the cost of such portion only as will, when added to the original cost of the property bettered, give the cost of reconstruction in present condition of property as bettered, should be charged as plant and equipment investment. The remainder of the cost of the changes should be classed as a repair and be charged to the appropriate expense accounts.

Replacements:

Replacements are those installations of plant and equipment which have for their purpose the substitution of one building, structure, piece of equipment, or machine for another which it has become necessary to retire, the substitute having substantially no greater capacity than the plant or equipment replaced. The cost of the plant and equipment retired should be removed from the accounts in which it is carried, and the cost of the plant and equipment installed in place of that so retired should be charged to the appropriate fixed investment accounts.

The foregoing are noteworthy general definitions. They may be of interest in preparing similar definitions applicable to any specific industry. Note that the ex-

penditures for betterments are to be capitalized so that the total investment shall not exceed the replacement cost of the property as improved. Also note that in case of replacements, the original investment is to be removed from the Investment account, being charged to the depreciation reserve or expenses, and the new investment set up in its stead.

Treatment of Additions, Betterments, Replacements, and Repairs

The policies controlling the fixed property investments of a business include the treatment of additions, betterments, replacements, and repairs, for the manner in which these expenditures are handled determines the tendency in fixed property investments towards conservative or non-conservative positions. Any organization, either large or small, should outline a definite policy for the handling and distribution of these expenditures —and this policy should, above all else, be conservative. The effect of a non-conservative method of handling these expenditures is the same as the effect of unwise expenditures for fixed investments, for it brings fixed burdens into the business in the same manner.

All of these elements have to be considered as a whole, and in relation to each other. The policy controlling the treatment of these expenditures must take into consideration:

1. The amount of depreciation to be provided.
2. What expenses are to be considered repairs.
3. What replacements are to be considered as expenses, and what chargeable to depreciation reserves.
4. What betterments are to be capitalized.
5. What additions are to be capitalized.

These have to be considered together when policies are being formulated, for the reason that proper treatment of any one is no assurance that the others are properly treated, and, in fact, proper treatment of one may be entirely offset by improper handling of others.

The adequacy of the amount set aside for depreciation reserve depends upon the treatment of renewals, replacements, and betterments. One concern, for instance, may use a relatively low rate in computing depreciation, and, by conservative handling of replacements and betterments, arrive at the same result as another concern using a much higher rate for depreciation but a less conservative policy in writing off replacements and betterments. No depreciation rate can be judged by itself without considering the distribution of these other expenditures. As suggested, a provision for depreciation adequate when replacements are handled on a conservative basis, might be entirely inadequate to take care of charges for replacements handled on a less conservative basis.

It is impossible to make definite statements with reference to the treatment of these items, which would be of general application, because these policies must be determined by individual companies on the basis of a study of the physical properties used by the business, the type of operations performed, competitive standards of industry, etc., and the policies to be followed should be definitely stated in its classification of accounts.

The turnover on fixed property investment expresses the relationship between the volume of business done and the amount of capital tied up in fixed property investments. This is one of the most fundamental relationships in an industrial enterprise. The turnover is the indicator or measure of this relationship.

The turnover on fixed property investment may be figured in either of two ways:

1. As the dollars of sales per year per dollar of fixed property investment.
2. As the physical units of volume per year (pounds, barrels, cases, etc.), per dollar of fixed property investment.

Of these, the latter is the sounder, for it is based on fixed measures which are unaffected by changing price levels.

Computing this turnover on the basis of sales and fixed property investment is satisfactory in normal times when prices are steady, but prices for products have fluctuated so greatly in recent years that changes in this turnover might be misleading unless changing price levels are recognized. Where no measure of physical volume is available it may be approximated by adjusting the sales figures sufficiently to eliminate the effect of changing price levels. This may be done by use of a price index. Published price indexes may be used when they are fairly representative of the trend of values of the particular products in question. Ofttimes an individual price index may be readily prepared on the basis of representative items of products handled. All propositions to increase fixed property investments should take into consideration the effect upon this turnover. Additional property investments should be justified by a similar relative and permanent increase in volume of business, in order to protect this turnover. To expand properties on temporary volume, or on volume resulting from inflated prices, would be most unwise, as many unfavorably situated now realize. The trend of this turnover is an indicator of the trend of unit fixed property expenses on the volume of business done. As the turnover improves, the unit expense decreases; and as the turnover decreases the unit expense burdens increase. As the fixed property expenses—depreciation, taxes, insurance, etc.—bear quite a constant relation to the amount of fixed property investment, volume changes mean better or poorer unit costs and expenses, and are also directly reflected in the turnover.

Financial and Expense Burdens of Increase in Property Investment

An effective method of emphasizing this point is to compute the added expense burdens imposed upon a business by any proposed increase in fixed property investments. As a general rule additional fixed property investments carry increased financial and expense burdens of about 20 per cent of the amount of such increase in property investment. This would be made up approximately as in Table 2:

These are averages and round figures, but they are

quite representative of the additional burdens imposed by the average addition to property investments. For any individual proposition the increased burdens may be figured out quite accurately, and it is very effective to state to the management and operating people that, for illustration, a proposed addition of $100,000 will impose upon the business annual fixed financial and expense burdens of $20,000, which should be covered by the profits from permanent additions to volume, or permanent savings in cost and expense, for otherwise they will reduce the return earned on the investment.

TABLE 2. FINANCIAL AND EXPENSE BURDENS OF INCREASE IN PROPERTY INVESTMENT

	Per Cent
1. Financial cost of the added investment—increased interest and dividend requirements	9
2. Average depreciation on building and equipment investments might be	5
3. Necessary repairs, taxes, insurance, and miscellaneous expenses might average	6
Making a total of	20

The advantages of a better turnover on fixed property investment may also be translated directly into terms of increased return on stockholders' investments (Table 3.) meaning smaller costs and expenses by 1.6 per cent on sales—and better results on the above net worth by 0.8 per cent per year. This illustration leaves out of consideration entirely the added profits realized on the increased volume, for the increased volume would likely carry the average margin of profit, and this would further enhance the return on the stockholders' investment.

Financing Fixed Property Expenditures

Expenditures for additions, betterments, and replacements for which no new capital is provided, have to come out of working capital. The fact should not be overlooked, that from the working capital point of view such funds are spent as truly as though paid out in dividends. Money tied up in fixed properties is no longer available as working capital; it cannot be used to pay bank loans, buy goods, or carry accounts.

Important new ventures, extensive construction programs, etc., are generally provided for by special financing. This would necessarily be the case with large expenditures. But it is the effect of the smaller and more or less regular and constant expenditures for additions, betterments, and replacements which is overlooked. In any going business some such expenditures are necessary every year. While they may not be important in any one period, it is the cumulative effect that is of importance. In very profitable times when surplus accounts are being built up, such items pass unnoticed, but, nevertheless, they accumulate year by year.

Surplus should be considered as free surplus available for payment of cash dividends only to the extent that such payment can be made without unduly depleting working capital. Surplus profits are usually first realized in the form of increased working capital. When this is the case, if cash dividends are paid out, both the Surplus account and the working capital are reduced. If long-term liabilities are retired, the working capital position should be protected by a charge against surplus and such financing as may be necessary to maintain an adequate working capital. Current expenditures from year to year for additions and betterments reduce working capital in the same way, and should be provided for by a charge against surplus and, as before, by such financing as may be necessary to insure an adequate amount of working capital.

A concern might go along for years putting a few thousand dollars each year into additions and betterments, and find that this drain on working capital had accumulated to a sum representing a very large part of its Surplus account. Withdrawing such sums from working capital means borrowing, for if these funds were not invested, they would remain as working capital. Temporary demands upon working capital are usually provided for by current borrowings, bank loans, etc., but there comes a time when added permanent financing is necessary to cover these fixed investments unless provided for by earnings retained in the business.

It is advisable that these expenditures for additions and betterments should be provided for by a transfer from free to appropriated surplus to assure that the working capital is maintained. When such expenditures accumulate to a large sum and added permanent financing is undertaken in the way of a bond or stock issue, the effect is to replenish working capital for these withdrawals, and release the surplus appropriated to cover. As the issue is floated the amount refinancing fixed investments paid out of earnings may be released from appropriated surplus, and transferred back to free Surplus account.

TABLE 3. INCREASED RETURN ON STOCKHOLDERS' INVESTMENTS

Assume a net worth of	$200,000
An annual volume of business of	300,000
A fixed property investment of	100,000
Indicating a turnover of	3 times
Fixed property expenses, interest, depreciation, taxes, etc.	20,000
Which figures on sales	6.6 per cent
Now assume the volume on the same fixed property investment could be increased to	$400,000
The turnover would then be	4 times
And the same fixed property expenses would average on sales	5 per cent

Styles of Construction—Advantages and Disadvantages

The advantages or disadvantages arising out of different types of construction and equipment should not be overlooked. The fixed expenses arising out of each possible type should be computed, and the effect on all possible changes in volume considered. Direct comparisons should of course be based on property and equipment investments to handle a certain volume of business. Comparative advantages in different types of buildings may be reduced to figures and summarized along the following lines:

The Expensive Layout	vs.	*The Inexpensive Layout*
1. Requires: More capital to finance		1. Requires: Smaller investment
2. More interest charges. (To be computed on entire investment)		2. Less interest charges (To be computed on entire investment)
3. More taxes on property		3. Less taxes on property
4. Probably less insurance on property		4. Probably more insurance on property
5. Probably less insurance on stocks		5. Probably more insurance on stocks
6. Probably less repairs		6. Probably more repairs
7. More or less depreciation		7. More or less depreciation
8. Possibility of obsolescence		8. Possibility of obsolescence
9. Probability of lighter protection		9. Probability of heavier protection
10. Possibility of saving in labor		10. Possibility of heavier labor costs
11. Possibility of savings in expenses, etc.		11. Possibility of heavier expenses, etc.

The costs of operation with each type of construction should be computed as accurately as possible, and reduced to unit costs on the same volume of business. This will express the advantage in favor of one or the other, which should receive careful consideration in determining the type of construction to be used.

Due consideration should be given to possible changes in wage rates which might affect the labor costs. Labor-saving investments which are profitable with high wage rates prevailing, may be unprofitable with lower wage rates. Possible changes in other expenses of operation should also be considered.

The question of future volume should also have attention. Would the same advantages of one type over the other exist, if volume were reduced to 50 or 60 per cent of capacity? Most of the above costs and expenses will remain about the same regardless of volume. If volume should drop off 50 per cent—and it has for many—which proposition would leave the concern in the best position?

It must not be assumed that the modern fireproof, well-equipped, expensively constructed property is always the best investment, nor on the other hand that the old-style plant is the least expensive to own and operate, everything considered. It has to be figured out for any particular proposition.

Burden of High Cost Construction Work

Construction work installed at high price levels should have consideration from two points of view:

1. The valuation of such investment in the financial statement.
2. The burden of fixed expenses which such investment places against the business.

High cost investments, made largely during the war period and immediately thereafter, will ordinarily be carried in the accounts at cost, except as reduced through amortization. If, however, such costs were abnormal and the difference between actual costs and replacement costs at balance sheet date is of importance, the fact must be taken into consideration in judging the financial position of a company, as it will probably affect its competitive standing materially.

Facilities provided at high costs for the production of war materials and supplies should, of course, be revalued and written down to their normal value to a going concern when used for whatever purpose available. The shrinkage unquestionably is a part of the cost of the war business. If the concern did not realize enough on that business to cover their costs and still have surplus to take care of this shrinkage in fixed investments made to handle that business, there is unquestionably a loss on such operation. This is one of the best answers to the free charges of profiteering common during these years.

Other high cost property investments made to care for regular business are commonly carried in the financial statement at cost less regular depreciation. These values may be higher than the present replacement value or the present market value. It is easy to recommend the conservative treatment, writing such investments down to about normal replacement costs. Unfortunately many businesses burdened with such investments are not in position to write them down.

Treatment of High Construction Costs

If serious competitive handicaps result from these investments there are three possible remedies:

1. Very conservative policies in the treatment of depreciation, repairs, replacements, and betterments.
2. Writing down the fixed investments by charges to Surplus account.
3. Reorganization.

The two latter remedies are severe measures, applicable only to extreme situations. By following very conservative policies for handling depreciation, repairs, and renewals over a period of years, a company may work out of an unfavorable situation, but this requires a sacrifice of earnings.

When considering writing down fixed property investments, it should be borne in mind that savings realized would be book savings rather than money savings. Tax values and insurable values will probably not be affected and these expense burdens would likely remain unchanged. The financial burdens also would probably be unaffected, for an adjustment to Surplus account would not reduce the liabilities or the amount of stock outstanding. Further, depreciation is not a cash entry, but a book entry, hence, money out of pocket costs incurred in operations would likely remain about the same.

These points should be taken into consideration in figuring costs, and it may be advantageous to compute costs on both a normal overhead basis and an actual overhead basis. Obviously, the actual overhead must be absorbed in results, for any other procedure would simply make a bad situation worse. This point, figuring costs on a normal overhead basis distinguished from an actual basis, is of importance when costs have sub-

stantial influence on selling prices. However, operating men should never be permitted to overlook the actual costs of doing business, even though they may make use of costs computed on a normal overhead basis.

Capitalizing Cost-Saving Expenditures

Cost-saving expenditures are generally of two types:

1. Changes in physical plant structures or equipment which involves expenditures for replacement.
2. Changes in plant layout, which do not involve replacements, but are simply rearrangements of the plant—moving expenses, etc.

In the first type, which involves replacement expenditures, the capitalization of the total costs incurred in making such changes may amount to capitalization of obsolescence. That is, if the saving is to be made by replacing one structure or machine with a different or more efficient one, the costs incurred will consist of the expenses of making the new installation together with the loss on that part of the cost of the original installation not covered by depreciation reserves.

In such cases the cost of the old installation should be removed from the investment accounts and the new installation set up in its stead at cost, which will include expenses incurred in installing. The cost of the old installation is considered as a charge to:

1. Depreciation reserves
2. Expenses
3. Surplus
4. Deferred charges

That part of the cost of the old installation covered by depreciation reserves should be charged off to such reserves. The balance should be charged to expenses, surplus, or deferred charges. If the item is relatively large it may be inadvisable to charge directly to expenses of any one period, in which case it should be charged to surplus or deferred charges, preferably to the latter, to be absorbed with promptness in the following periods. To leave such an item in the Investment account is in reality capitalizing obsolescence, and would result in carrying the plant investments at more than their replacement values.

To capitalize cost-saving expenditures simply because the savings represent a fair return on the investment is not an adequate test for capital charges. Such a policy, followed long enough would result in most unwarranted inflation of property values. The older a plant gets, the more readily cost-saving expenditures can be figured out. Usually the costs of operating such units are heavy enough without adding burdens by capitalizing obsolescence.

Expenditures for changes in a plant—moving, equipment, etc.—which make savings but do not increase the property values, should always be charged to expenses, or if large, to deferred charges, and quite promptly written off. To capitalize such expenditures would raise the property values above the replacement costs, and is simply inflation. The fact that they effect savings in expenses is a reason for charging them off rather than for capitalizing them.

Controlling Cost-Saving Expenditures

The necessity for a complete control over construction expenditures has been emphasized in preceding sections. The best means of acquiring control over such expenditures is to require a definite appropriation to cover their amount, based on a most comprehensive estimate of costs and complete analysis of the proposition. Such appropriations should be required for all expenditures for construction work, for replacements, betterments, and extraordinary repair jobs. Some concerns control such expenditures by requiring special appropriations for all jobs estimated to cost more than a certain sum, say $100 or $500, depending on the local situation.

Where such a plan is followed, the request for the appropriation should be worked out in detail in the form of a statement by a prospectus, setting forth:

1. The exact character of the work proposed.
2. The estimated cost of the work.
3. The necessity for doing the work.
4. The loss on properties retired (if any).
5. Possible alternatives, and their costs.
6. The savings to be realized by the expenditure.
7. The net return to be earned on such an investment through greater efficiency, larger capacity, lower costs, etc.
8. The distribution of the expenditures: To capital, reserves, expenses, etc.

The only time to obtain a control over construction expenditures is before they are made. Too much care cannot be given to the working out of a proposition to make added fixed investment. It should be complete, accurate, and final. Beyond all, the estimate should cover all expenditures required, both directly or indirectly. Such appropriations should have the approval of the operating department and the accounting, financial, and executive heads of the business.

A convenient method of handling the accounting is to carry a ledger under a Construction in Progress account, providing an account for each appropriation. As charges are passed they should be entered against the proper appropriation. When the job is completed the cost should be cleared from the Construction in Progress Appropriation account and charged to the proper fixed property investment accounts, under Land, Buildings, Machinery, etc.

Where work includes extraordinary repair jobs, or contains an element of repair expense, the expenditures should be analyzed at the close of an accounting period, and the repair element removed from the Construction in Progress account and charged to expenses. This is quite readily done by reviewing and summarizing expenditures on open jobs in this ledger. Where the final cost is to be distributed, a percentage to repairs and a percentage to other accounts, the expenditures within a period should be split on that percentage basis.

(To be continued in the May issue.)

A Conveyor System that Revolutionized a Cotton Mill

Mechanical Handling Methods at the Jackson Mills

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AT the annual meeting of the American Society of Mechanical Engineers last December, E. H. McKitterick, of Lockwood, Greene and Company, presented a paper dealing with management in the textile industry. In this paper, he referred to a conveyor system developed in some of the mills with which his company was associated, that had effected marked and profound changes in the operation of these mills. At the same meeting, the author presented a paper based on the argument that good management must be preceded by, and is dependent on, good mechanical engineering.

One of the plants in which the conveyor system has been installed is the Jackson Mills at Nashua, New Hampshire. The revolutionary effect of the conveyor on the entire operation of the mill forms a most convincing argument for the position of the author in regard to the relationship between engineering and management. The conveyor has done more than perform its natural function of moving material from operation to operation with a minimum of labor cost. It has, by the characteristics inherent in any continuous conveyor system, completely changed the viewpoint of management, and has caused the development of a science governing the various operations of a textile mill in a manner that has heretofore been considered impossible.

The Accomplishments of the Conveyor

The continuous and regular delivery of material at any point compels the adoption of means to remove this material as rapidly as it is delivered. In the textile mill this requirement leads to a study of processes and of machine operation to develop a system that will enable the machines to keep ahead of the conveyor at all times. It has also compelled the training of operators in the methods of handling their machines and of taking advantage of the possibilities of the conveyor in increasing output. The net result, then, of the installation of a conveyor has been not only a decrease in the direct labor cost of handling work to and from machines, but a decrease in the labor cost on the machines, a decrease in the idle time of machines, and a marked increase in production. The increase in production is due both to the elimination of idle machine time and to the increased skill of the workers as a result of the development of the science underlying each class of work.

A discussion of the conveyor system and its effect on production naturally divides itself into two parts: (1) A description of the conveyor and of the mechanical devices which enable it to operate automatically; and (2) a discussion of the influence of the conveyor on the management problem. In the present article, we will consider the conveyor simply as a machine for transporting material. In a subsequent article, we will analyze its effect on the work of the mill and on its personnel.

The conveyor system is designed to handle the entire product from the raw cotton to the finished cloth with the exception of movement between one or two operations, where hand labor is more economical, and the actual transfer of material between individual machines and the conveyor loading and delivery points. Due to the numerous different functions that it is required to perform and the varying conditions existing at different stages of the process the conveyor is not a single mechanism. It consists of a combination of belt and gravity roller-conveyors, spiral chutes, chain-belt inclined and vertical elevators, and various loading and unloading devices. The general arrangement of these various devices and their relation to one another is shown in Fig. 1. Details of the actual installation as made at the Jackson Mills are shown in Figs. 2 to 9.

At the Jackson Mills, the cotton bales are opened in the basement and the cotton is blown through pipes in the usual manner to the picker-room on the top floor. Thereafter all transportation is by gravity or by horizontal belt-conveyors with the exception of the return of empty containers. For this purpose, elevators or inclined conveyors somewhat similar to car-hauls are used. The adoption of a conveyor system, however, does not require this particular arrangement. Material could be moved upwards by power just as easily as it is moved downward by gravity. In fact, it is doubtful in view of some of the experiences with the gravity system whether the particular arrangement shown in Fig. 1 would be repeated. This particular installation was largely experimental in character, and despite its unqualified success a somewhat different arrangement might give even better results.

Insuring Regular Deliveries from the Pickers

The pickers are arranged in a row on the top floor, being divided into two batteries. In front of each battery is a gravity roller-conveyor A, on which are carried the cradles in which the laps are placed as they are made by the pickers. The conveyors deliver

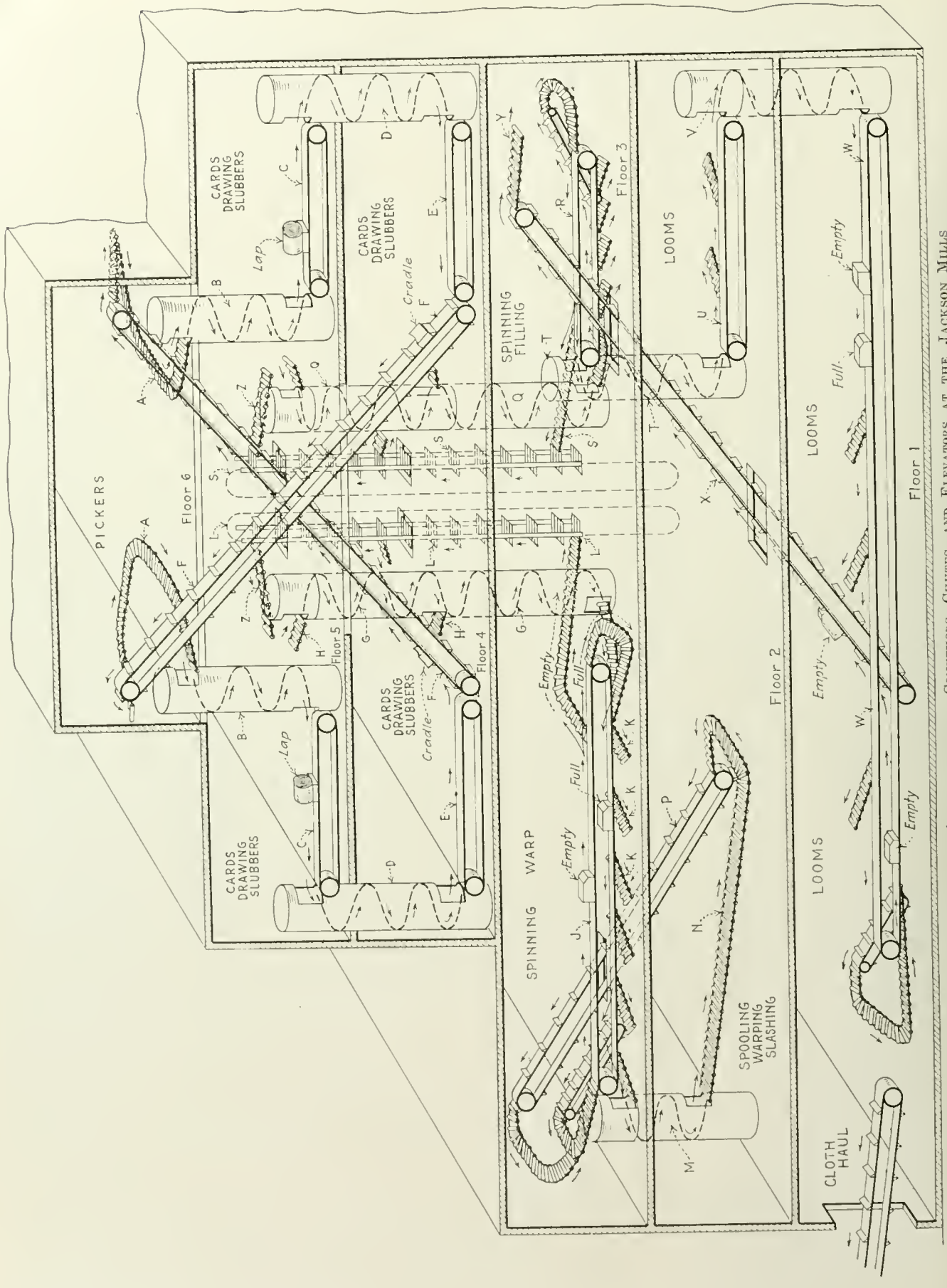

FIG. 1 DIAGRAM OF THE ARRANGEMENT OF CONVEYORS, CHUTES, AND ELEVATORS AT THE JACKSON MILLS

the cradles and laps to the spiral gravity chutes B, at each end of the picker-room. To insure the delivery of the cradles at regular intervals to the chutes, the section of the conveyor just in front of the chute is made in the form of a tilting table. A stop at the end nearest the chute prevents the cradles from entering, and a similar stop just ahead of the entrance to the tilting table prevents a cradle from landing on it until it has discharged and returned to its normal position. A motor-driven cam releases the stops and tilts the table at intervals of about 45 sec., sending the cradle into the chute. The stop and table return to position as soon as the cradle leaves, and the stop at the entrance to the conveyor is then released and another cradle enters the table, being held there until the cam again releases it.

Fig. 2 shows the conveyor in the picker-room. The chute is at the far end. The conveyor against the ceiling is the upper run of the same conveyor which receives the cradles from the elevator, described elsewhere, which returns the empty cradles from the card room below.

The two floors below the picker-room are occupied

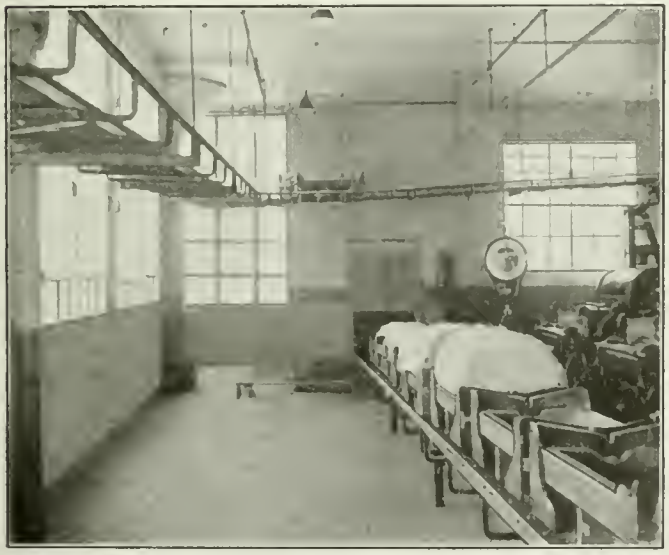

FIG. 2 LAPS ENTERING CHUTE FROM THE PICKER-ROOM
Note automatic release mechanism at left of conveyor.

by the cards, drawing frames, and slubbers. In each of the four rooms is a belt-conveyor which consists of a belt traveling over the rollers of an ordinary gravity-roller conveyor, set in a horizontal position. The laps on their cradles are delivered from the chute B to the conveyors C on the upper floor, and are removed by hand as needed by the carding machines. Fig. 3 shows this conveyor and the delivery end of the chute from the picker-room.

The laps remaining on the belt, together with the empty cradles, pass to spiral chutes D at the far end of the conveyors. These chutes deliver them to similar belt-conveyors E on the floor below. At the opposite end of the belt-conveyors E, are two inclined elevators F, which extend to the top of the picker-room. The empty cradles on the conveyors E are delivered to the elevators by the conveyors and returned to the picker-room. The elevator discharges to the upper run

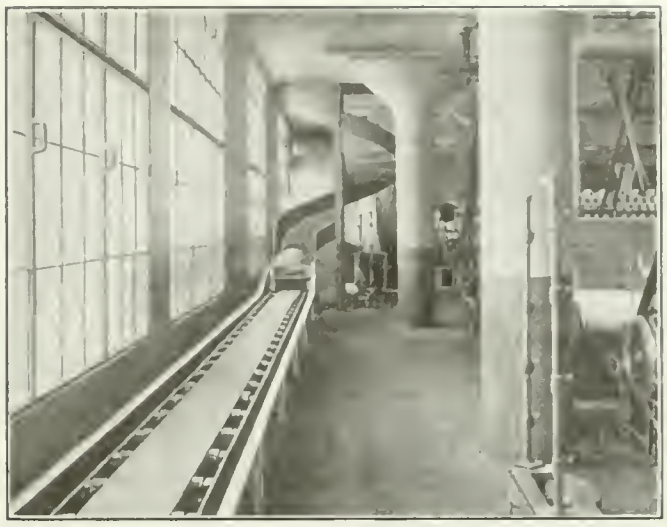

FIG. 3 THE LAPS FROM THE PICKER-ROOM ARE DELIVERED TO THE BELT-CONVEYOR IN THE CARD ROOM

of conveyor A, the cradles moving down by gravity to the lower run in front of the pickers. Laps which are not removed in the card rooms return to the picker-room via the elevators and repeat the circuit.

The discharge point of conveyor E and the loading end of elevator F are shown in Fig. 4. This also shows the construction of the latter. The cradles slide on longitudinal stringers. On each side of the conveyor is a chain belt, with rods placed at regular intervals joining them and extending across the runway of the conveyor. The belt projects the cradle across the roller tables shown to the foot of the elevator. A rod comes up behind it and propels it up the incline. Should it land on the elevator in such a position that the rod will fail to come behind it, the cradle will ride on the rod until it strikes the incline, when it will drop off the rod, to be pushed up the incline by the next following one.

In the card room the cards, drawers, slubbers, and roving machines are so placed in relation to one another that no conveying equipment is necessary. The delivery point of one is opposite the feed point of the next

FIG. 4 AN INCLINED ELEVATOR RETURNS THE EMPTY CRADLES TO THE PICKER-ROOM

machine in line, so that material can be transferred by hand with equal facility and less expense than a conveyor would entail. With a different arrangement of machinery, however, a conveyor system might easily prove profitable.

As the work comes from the roving machines, the conveyor system picks it up once more and from thence forward most of the handling is done by mechanical means. It is still necessary to doff and load the machines by hand and to move the boxes containing the filled bobbins and spools to the conveyors. Aside from this there is practically no hand work in moving of material until the warps are made. And even the movement of boxes to the conveyors has been made semi-automatic by the development of labor-saving devices described later.

The roving machines are doffed into boxes which are carried on special trucks to the conveyors leading to the chutes which move them to the spinning-room. These trucks are an important part of the system and are one of the labor-saving devices mentioned above. Referring now to Fig. 1, it will be observed that the processes and conveying system for both sides of the mill are the same up to this point. From this point on, however, the material divides, part of it going to the spinning frames to be made into yarn for the warps. The balance is spun for the filling of the finished cloth. Since the former portion passes through more operations than the latter, the conveying system is no longer uniform. We will first follow the cotton through the warp to the loom.

Starting at the floor below the picker-room, that is on floor 5, Fig. 1, where the roving is made, a gravity spiral chute descends through two floors to the spinning-room. This is chute G, Fig. 1. It can be loaded on either of the two floors through which it passes by an ingenious arrangement which not only delivers the boxes of roving at regular intervals, but prevents loading on the lower floor from interfering with boxes coming from the floor above. In the roving-rooms the boxes are unloaded from the trucks heretofore mentioned to the inclined belt-conveyor shown in Fig. 5.

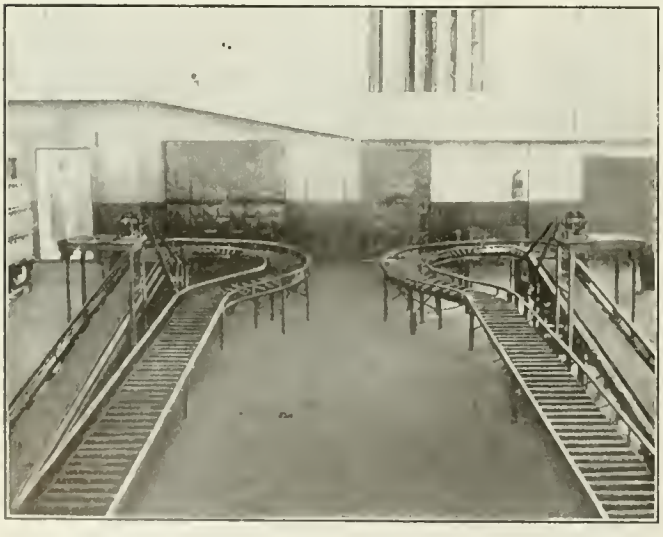

FIG. 5 BELT-CONVEYORS PLACE BOXES OF ROVING ON THE ROLLER-CONVEYORS WHENCE THEY PASS DOWN CHUTES TO THE SPINNING-ROOM

This raises them to the top of the gravity roller conveyor H. At the end of this latter conveyor is a tilting table with stops, similar to those guarding the entrance to chutes B in the picker-room. The tables and stops on the two floors are controlled by a motor-driven cam on the upper floor, which so synchronizes the two sets that they admit boxes to the chute from the two floors alternately. The conveyors H act as reservoirs for the boxes, and while there may be quite a string of them on the conveyors, only one at a time is admitted to the chute and that only when the chute is clear.

Automatic Supply Stations

At the lower end of chute G is a belt-conveyor J. The boxes from the chute land on its lower run and are automatically diverted to supply stations K holding three boxes each. If the supply stations are all filled, the boxes continue to the end of the conveyor where they are diverted to a short belt-conveyor and transferred by it to the upper run of the main conveyor. When they reach the beginning of the conveyor, they are again diverted automatically to the lower run, to repeat the circuit until they finally land in a supply station.

The supply stations consist of sections of roller conveyor just long enough to hold three boxes of roving. They are set at an angle to the main conveyor as shown in Fig. 6. A box moving along the conveyor

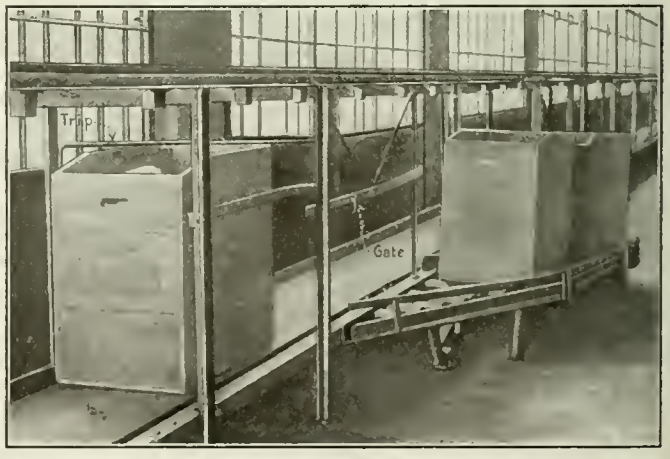

FIG. 6 AUTOMATIC GATES DIVERT BOXES OF ROVING TO SUPPLY STATIONS

strikes the trip shown in Fig. 6. This causes the gate across the entrance of the station to swing across the belt-conveyor at such an angle as to divert the box from the belt to the supply station conveyor. When the station has received its quota of three boxes, the last box to enter rests on a lever which raises the trip so that the next box on the conveyor passes underneath it. The diverting gate thus remains stationary and the box passes on to the next unfilled station. As boxes are removed from the end of the short conveyor forming the station, the remaining boxes move forward, releasing the trip and diverting the next box on the main conveyor to once more fill the station.

Empty boxes are placed on the lower run of the

conveyor. The tops of the boxes are beveled so that one end is lower than the other. The empty boxes are placed low end first on the conveyor. The necessity of properly placing full and empty boxes high and low ends first respectively is the only feature wherein the human equation enters the operation of the conveyor system. In every other respect its action is entirely automatic. Moving bevel end forward, the empty boxes nose their way under the trip, the bevel lifting it out of engagement with the gate, so that the empty box passes to the end of the conveyor, there to be transferred to the upper run which delivers it to the elevator L.

The elevator L, comprises a pair of chain belts running over sprockets at the top and bottom with carriers

FIG. 7 THE SUPPLY CONVEYORS IN THE WEAVE ROOM BRING THE BOBBINS FOR THE FILLING DIRECT TO THE LOOMS

swung between the chains. The conveyor delivers the boxes on a series of fingers in the upward path of the carriers, which are slotted to pass the fingers. As the carrier moves through the fingers it picks up the box thereon, carries it over the head-shaft of the elevator, and deposits it on a similar set of fingers on the downward run at either the fifth or fourth floor, whence it runs out to a gravity roller-conveyor Z, which acts as a storage for empty boxes. The unloading fingers can be so set as to cause the boxes to be delivered at either floor as desired.

From Spinning Frames to Warping

Conveyor J is also used to transfer boxes of yarn from the spinning frames to the spooling and warping room on floor 3. The spinning frames are doffed into boxes which are lower than those coming from the roving machines. They thus pass under the automatic gates at the supply stations K and move directly to the

FIG. 8 THE MAIN CONVEYORS IN THE WEAVE ROOM

spiral chute M, which delivers them to the gravity roller-conveyor N. This conveyor, which is quite long, also acts as a storage space for the boxes until their contents are needed for the spoolers. Empty boxes are returned to the spinning-room by means of the inclined elevator P.

The warp beams are handled to the slashers, tying-in machines and looms on special trucks. Owing to the relative infrequency of movement of the warps, this method is more economical in the present instance than a conveyor.

From Spinning Frames to Looms

The material for the spinning frames supplying the filling for the looms, during the first part of its course, follows a path similar to that of the yarn for the warp. It passes down the chute Q, from the card rooms, to the conveyor R. The loading arrangement for the chute and the supply stations on the conveyor R are identical with those for the warp spinning-room. Empty boxes are returned by means of elevator S, which is similar in all respects to elevator L. The small boxes, filled with bobbins doffed from the spinning frames, are placed on the lower run of conveyor R, transferred at its end to the upper run, dodging the diverting gates to the supply stations on the way, and pass down the spiral chute through to the upper run of conveyor U. From this conveyor, they are automatically diverted to long supply stations alongside each row of looms. Boxes in excess of those needed to fill the supply stations on floor 2, descend through the chute V to the upper run of the belt-conveyor W, shown in Fig. 8, and are diverted to supply stations as needed.

The empty boxes are used to convey back to the spinning room the used bobbins from the looms. They are placed on the upper run of conveyor U, pass the diverting gates, and descend through chute V to conveyor W. They travel the full length of this conveyor and at its end are transferred automatically to the lower run. From the lower run, they pass to the inclined elevator X, which raises them to the spinning-room

on floor 3. Here they run out on the roller-conveyor Y, whence the bobbins are distributed to cleaners who strip them of all yarn remaining on them. The boxes are distributed to the spinning frames once more to repeat the circuit.

The rolls of finished cloth from the looms are transferred from the weave room to the cloth room by a chain haul of the usual type. They are taken to the haul on trucks on which several rolls of cloth stand on end. The chain haul delivers the rolls of cloth to platforms set at right angles to the line of the haul, to which they are connected by movable bridges. The cloth is then trucked from these platforms to platforms behind the operators of the cloth inspection machines. A movable bridge from this platform enables the operator to transfer rolls of cloth to the machine without assistance. From the inspection machines the cloth is trucked to sewing machines which sew several small rolls of cloth together to make a roll weighing about 1000 lb. It is then brushed and rolled, and piled on trucks, five rolls per truck, for shipment.

FIG. 9 OPEN CHUTES MADE OF RAILS HAVE PROVED MORE EFFECTIVE THAN SOLID CHUTES

Details of the System

The foregoing paragraphs have traced the progress of material through the mill from raw cotton to finished cloth. In order to preserve the continuity of the argument, descriptions of several of the minor details which had a marked influence on the success of the conveyor system were omitted. These can now be taken up.

Prominent among the labor-saving devices is the truck used for handling the boxes from the roving machines. The platform of the truck, which is just long enough to hold two boxes, is a section of roller-conveyor. It is carried on a pair of wheels at the midpoint of its length with a single smaller wheel at each end to enable it to be tilted slightly in either direction. A stop at each end prevents the boxes from sliding off the platform of the truck. When the boxes are filled, the doffer wheels the truck a short distance to the conveyor leading to chutes G or Q, Fig. 1, lines it up between guides and pushes it against the end of the conveyor. A latch on the guides depresses the stop on the truck at the conveyor end, and, the truck being tilted downward, the boxes roll onto the conveyor. The empty truck is then moved to the roller-conveyor Z. Contact with the end of the conveyor likewise depresses the stop at the end of the truck and at the same time releases a stop on the end of the conveyor, permitting two boxes to roll onto the truck. A second stop on the conveyor holds the remaining boxes back until the first two have been loaded on the truck, when the whole string moves forward into position for the next truck.

The Spiral Chutes

In the development of the system considerable trouble was encountered with the spiral chutes, especially those leading from the spinning-room. The descent of the boxes was so rapid that the centrifugal force developed threw a considerable number of bobbins from each box. The remedy evidently was to elevate the outer edge of the chute so that the track would be banked. This was difficult with a chute of the solid type, but finally after much experimenting the chute shown in Fig. 9 was devised.

This chute consists simply of rails carried on brackets supported by a central standard. The brackets are adjustable in the vertical plane so that the track can be banked at any angle desired. This construction not only eliminated all trouble from spilling, but also was more desirable from the lighting standpoint, the open chute casting less dense shadows than the solid type.

The vertical openings in the floors for the chutes and elevators raised the question of fire protection. The fire underwriters are rigid in their regulations concerning vertical hazards of this character and the plans had to meet their approval before the system could be installed. The method of guarding these openings finally adopted was to enclose the top of each chute or elevator in a concrete pent-house with an automatic vertical sliding fire door closing the opening through which the material passed. To prevent water used in extinguishing fire on one floor from flowing through the openings to the floor below, the pent-houses were set on raised concrete platforms about 6 in. high.

While the problem at the Jackson Mills was simple, in that the product is of uniform character, the experience with the conveyor indicates that it would not be difficult to adapt it to textile mills where the problem is more complicated. In fact, the development of the conveyor system probably represents one of the greatest forward steps in the textile industry that has been made in many years. A discussion of its economic effects on this industry will appear in the May issue of MANAGEMENT AND ADMINISTRATION.

The system at the Jackson Mills was developed by Lockwood, Greene and Company, Engineers. Charles M. Mumford of that organization was in charge of the work, and to him is due much of the credit for its success.

The major part of the equipment was made by the Standard Conveyor Company, while special parts were furnished by the Lamson Company and the Norfolk Iron Works.

Pricing Policy Applied to Financial Control

IV—Tuning Up General Motors

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Index Number
658.14 Financial control
338.58 Price analysis

THE preceding article indicated the kind of considerations which may lead to a modification of the *base price*. Apart from this, deviations of actual price from the *base price equivalent* in current periods may be justified by special considerations, of which the following are examples:

1. The necessity of meeting competitive conditions existing at any time, not admitted to be of a permanent character.
2. The necessity of making allowances for any extraordinary circumstances existing with respect to price of raw materials in hand or under contract, or other existing cost abnormalities.
3. Consideration must be given to the probable trend of raw material and labor costs, and allowance made for possible changes over an interval during which no price adjustment is desirable.
4. High prices in periods of high volume with correspondingly low prices in periods of low volume will tend to flatten the production curve, and consequently increase the productivity of capital employed.
5. Low prices are desirable in periods of reduced volume to stimulate demand; but a price cannot be fixed below the *base price equivalent* unless the resulting decrease in profits can be recouped during periods of high volume through the establishment of prices correspondingly higher.
6. It must be recognized that capital normally enjoys a high rate of return in periods of high volume, and that higher prices at such times will intensify the attraction of competitive capital under speculative or ill-advised considerations.

The method of analysis which has been outlined divides the pricing problem into the following parts:

1. Bearing upon the Matter of Policy:
   (*a*) The question of what has been described as the *economic return attainable*, representing the average annual rate of return which should be expected upon capital employed.
   (*b*) The question of capital requirement, which may be said to qualify the consideration of policy.
2. Bearing upon the Matter of Administrative Procedure:
   The question of the application of the *base price*. This may be said to afford the co-ordinating link between questions of policy and of administrative procedure.

A clear appreciation of the individual character and, at the same time, interdependence of these phases of the problem has important results. It facilitates two things:

1. Organized contact with conditions, and interpretation of them, leading to an intelligent enunciation of policy.
2. Effective exercise of authority, within appropriate bounds, on the part of executives engaged in the direct conduct of business.

The supply of capital, whether from retention of earnings or from sale of securities, is dependent upon the promise of a satisfactory rate of return, which in turn is determined by the profit margin in relationship to capital turnover. This relationship is symbolized by the *base price*. A deviation in prevailing price from the *base price equivalent* may afford a practical demonstration that a previously assumed *economic return attainable* is erroneous, and thus lead to a limitation upon the supply of capital for expansion. This method of price analysis, therefore, supplies the basis of a pricing policy which is the embodiment of a financial policy.

Illustration of the Method of Price Analysis

Ordinarily prices cannot be fixed according to mathematical rule, or at figures calculated to yield a predetermined rate of return upon capital employed. Competitive conditions and other practical considerations are more apt to determine the prices which should be established, with the result that actual prices will rarely coincide exactly with the theoretical prices in accordance with an expressed pricing policy. This fact, however, does not mean that the expression of policy loses its significance; on the contrary, it makes clear the importance of interpreting the conditions which lead to apparent departure from the expressed policy, with a view to determining whether a modification of policy is required, or whether the conditions are of temporary import.

The availability of additional capital for expansion is dependent upon an expectation of the average rate of return obtainable. If actual conditions, as interpreted, demonstrate that a previously expected average rate of return upon capital employed in a given operation is no longer obtainable, the result may be a deliberate restriction upon further expansion, or even a curtailment of volume with release of capital for em-

ployment in more profitable channels. The analysis of price is just as important from the standpoint of indicating the rate of return obtainable upon capital employed as from the standpoint of determining the prices which should be established upon the product. The method of price analysis described in the preceding articles has the important attribute of segregating questions of policy from those of administration, and of facilitating the analysis and interpretation of price as bearing fundamentally upon matters of financial control.

The formulation of the pricing policy must be with regard to the particular circumstances pertaining to each individual business and to the industry of which it is a part, and generally is a matter of broad business judgment. When formulated it is expressed simply in the conception of what have been defined as *standard volume* and the *economic return attainable*. The question of the percentage of practical annual capacity which shall be set as standard volume must be dependent upon considerations such as the magnitude of annual sales volume fluctuations over a period of years (business cycle), the extent of seasonal fluctuations in sales likely within years of large volume, the policy of the company with respect to seasonal accumulation of finished or semifinished product with a view to leveling the production curve, the necessity or desirability of maintaining excess plant capacity for emergency use, and kindred matters. The question of the *economic return attainable* is dependent upon many factors which come to a focus in the broad judgment of executives as to the highest rate of return which can be obtained on capital, consistent with a healthy growth of the business.

TABLE 6. PLANT CAPACITY AND STANDARD VOLUME EQUIVALENT

Daily Production Capacity	225 Units
Theoretical Annual Production Capacity (280 working days)	63,000 Units
Practical Annual Capacity (allowing for machine shut-downs, seasonal fluctuations in shipments, etc.)	50,000 Units
Standard Volume	80 Per cent
Standard Volume Equivalent	40,000 Units

The application of the method of price analysis results in the determination of what has been defined as the *base price*, stated as a ratio or percentage of factory cost. The *base price* applied to the accounted factory cost of product determines what is known as the *base price equivalent*, which represents, theoretically, the price which should be established on the product to accord with the expressed policy. In the process of price fixing, this theoretical price should be set forth, and where the actual established price differs from the same there should be a clear understanding of the reasons leading to such deviation.

There is no hard and fast rule by which prices can be fixed, which would be uniformly applicable in a variety of cases. The *method of price analysis* outlined, however, is uniformly applicable, and may be illustrated by the following hypothetical figures. To simplify the matter, the statements are drawn up on the supposition that there is but one product of manufacture, and that its price is in exact agreement with the theoretical price.

For the purpose of illustration it will be supposed that the pricing policy is expressed by the following:

Standard Volume = 80 per cent of practical annual capacity.
Economic Return Attainable = 20 per cent on capital employed.

This is a complete expression of the policy, and simply means that, generally speaking, prices are to be established from time to time for the product which will yield an average annual rate of return, over a long period of time, of 20 per cent on capital employed in the business, provided the plants or factories operate at an average rate of 80 per cent of annual capacity.

TABLE 7. ANALYSIS OF MANUFACTURING EXPENSE AT VARIOUS VOLUMES

Item	Amount			
			(*Standard Volume*)	
Annual Rate of Production —Units	55,000	50,000	40,000	30,000
Productive Labor	$8,250,000	$7,500,000	$6,000,000	$4,500,000
Manufacturing Expenses:				
Fixed Expenses	2,000,000	2,000,000	2,000,000	2,000,000
Partially Controllable Expenses	9,325,000	8,750,000	7,600,000	6,450,000
Controllable Expenses	550,000	500,000	400,000	300,000
Total Manufacturing Expense	$11,875,000	$11,250,000	$10,000,000	$8,750,000
Ratio of Manufacturing Expense to Productive Labor	1.439	1.50	1.66⅔	1.944
Manufacturing Expense per Unit	$215.91	$225.00	$250.00	$291.67

TABLE 8. OVERABSORBED AND UNABSORBED BURDEN AT THE VARIOUS VOLUMES

Item	Amount			
			(*Standard Volume*)	
Annual Rate of Production —Units	55,000	50,000	40,000	30,000
Burden, Per Unit, Absorbed in Accounted Cost	$250.00	$250.00	$250.00	$250.00
Total Burden Absorbed	13,750,000	12,500,000	10,000,000	7,500,000
Actual Burden	11,875,000	11,250,000	10,000,000	8,750,000
Overabsorbed Burden	$1,875,000	$1,250,000	.....	.....
Unabsorbed Burden	.....	.....	.....	$1,250,000

Standard Volume Equivalent. In the application of the method of price analysis, *standard volume* must be reduced to its equivalent in physical volume, expressed either in units of product, tonnage, or value of plant output. With each increase of plant capacity there may be no change in *standard volume* as the expression of policy, but there will be a corresponding increase in the *standard volume equivalent* as representing physical volume. For the purposes of this illustration it will be supposed there is a plant of rated capacity and *standard volume equivalent* as in Table 6.

Standard Factory Burden. It is assumed that Table 7 represents an analysis of manufacturing expense at various volumes.

The *standard volume equivalent* has been stated as

40,000 units. Manufacturing expense is absorbed in the factory cost of product on this basis at all volumes of production. Thus, if manufacturing expense is absorbed, as factory burden, on the basis of productive labor the standard burden rate will be 166 2/3 per cent, which will be applied at all times. Similarly the factory burden absorbed in the accounted cost will be $250 per unit regardless of what the volume of production might be at a given time. In this way there will be overabsorbed and unabsorbed burden, Table 8, at the various volumes.

The overabsorbed or unabsorbed burden is carried directly to the income account.

Factory Cost of Product. It is supposed that fluctuations of volume will not serve to alter the raw material cost and the productive labor cost per unit of product, and that accounted cost will be as in Table 9.

TABLE 9. ACCOUNTED COST PER UNIT OF PRODUCT

ITEM	FACTORY COST PER UNIT OF PRODUCT
Raw Materials	$600
Productive Labor	150
Burden, at Standard Rate	250
Total Factory Cost, as Accounted	$1,000

Standard Commercial Expense. It is customary to allow for commercial expense as a given percentage of annual sales. Table 10 represents an analysis of commercial expenses at various volumes.

TABLE 10. ANALYSIS OF COMMERCIAL EXPENSES AT VARIOUS VOLUMES

ITEM	AMOUNT			
			(*Standard Volume*)	
Annual Sales, Units	55,000	50,000	40,000	30,000
Annual Sales, Value	$68,750,000	$62,500,000	$50,000,000	$37,500,000
Commercial Expenses:				
Fixed Expenses	$1,600,000	$1,000,000	$1,600,000	$1,600,000
Partially Controllable Expenses	$1,525,000	$1,450,000	$1,300,000	$1,150,000
Controllable Expenses	825,000	750,000	600,000	450,000
Total Commercial Expense	$3,950,000	$3,800,000	$3,500,000	$3,200,000
Per Cent of Annual Sales	5.75	6.08	7.0	8.53

Annual sales of 40,000 units representing standard volume, with commercial expenses at 7.0 per cent, it follows that this is the *standard allowance.* Actual commercial expenses are charged to operations.

Standard Fixed Investment Ratio. The standard fixed investment ratio is readily obtained, once standard volume and standard cost have been determined:

Investment in Plant, Equipment, and Real Estate = $15,000,000
Standard Volume = 40,000 units
Fixed Investment per unit of Product at Standard Volume = $375
Factory Cost of Product per unit = $1,000

$$\text{Standard of Fixed Investment} = \frac{\$375}{\$1,000} = 0.375 \text{ of Annual Factory Cost}$$

Working Capital Ratios. Other capital requirements are of variable character and will be in proportion to volume of business. Standards are established for these, Table 11, and are expressed as ratios to factory cost, or to sales, on an annual basis, according to whether the item is more directly related to costs or to sales value.

TABLE 11. STANDARDS EXPRESSED AS RATIOS TO FACTORY COST, OR TO SALES, ON AN ANNUAL BASIS

ITEM	STANDARDS	
	Ratio to Sales Annual Basis	Ratio to Factory Cost Annual Basis
Cash	0.050	....
Drafts and Accounts Receivable	0.100	....
Raw Material and Work in Process	....	0.16⅔
Finished Product	....	0.08⅓
Gross Working Capital	0.150	0.250

TABLE 12. APPLICATION OF STANDARD RATIOS AND PERCENTAGES TO ARRIVE AT BASE PRICE

ITEM	STANDARDS		
	Ratio to Sales (Annual Basis)	Ratio to Factory Cost (Annual Basis)	Ratio to Sales[1] (Annual Basis)
1. Cash	0.050	.....	0.050
2. Drafts and Accounts Receivable	0.100	.....	0.100
3. Raw Material and Work in Process	.....	0.16⅔	0.13⅓
4. Finished Product	.....	0.08⅓	0.06⅔
5. Gross Working Capital	0.150	0.250	0.350
6. Fixed Investment	.....	0.375	0.300
7. Total Investment	0.150	0.625	0.650
8. Standard Economic Return Attainable—20 Per Cent	.....	.....	.....
9. Final Net Profit (7 x 8)	0.030	0.125	0.130
10. Standard Commercial Expense—7 Per Cent	0.070	.....	0.070
11. Gross Margin on Factory Cost	0.100 a	0.125 b	0.200

[1]These ratios are easily arrived at after determining the *base price*, by carrying forward the ratios in column 1 without alteration, and the ratios in column 2 after dividing by the *base price*.

Base Price. The pricing policy having been expressed, and standards having been established for all expense and investment items, expressed as ratios to sales or to factory cost (depending upon the directness of the relationship), the *base price* can be readily determined. To arrive at the *base price* it is necessary only to apply the standard ratios and percentages referred to above, as illustrated in Table 12, from which the following is derived:

$$\text{Base Price, net to company} = \frac{(1+b)}{(1-a)} = \frac{1.+0.125}{1.-0.10} = \frac{1.125}{0.90} =$$

1.25 = Ratio of base price (net to company) to factory cost

Therefore, Base Price = 125 per cent of factory cost

Base Price Equivalent and List Price. With the factory cost established as $1,000 per unit, the *base*

price equivalent would be 125 per cent of $1,000 or $1,250, which figure represents the selling price *(net to company)* in conformity with the *base price*.

If the average discount to dealers is 20 per cent, the retail list price in conformity with the *base price* would be $\frac{\$1,250}{0.80} = \$1,562.50$.

The retail list price in conformity with *base price* may also be stated as $\frac{125 \text{ per cent}}{0.80}$, or 156.25 per cent, of factory cost (156.25 per cent of $1,000) or $1,562.50.

Non-Controllable Expenses at Different Volumes of Production. Since manufacturing expenses and commercial expenses do not increase or decrease in direct proportion to changes in volume of business, estimates of profits at varying volumes of business must take into account the degree of variability or controllability of these expenses, in order that the percentage of net profit to sales may be calculated. Similarly, that portion of the investment referred to as "Fixed Investment" (Real Estate, Plants, and Equipment, etc.) is constant regardless of the volume of business transacted, and influences the percentage earned on capital employed. Table 13 illustrates the non-controllability of manufacturing expenses and commercial expenses.

TABLE 13. NON-CONTROLLABILITY OF MANUFACTURING EXPENSES AND COMMERCIAL EXPENSES

Item	Amount			
Various Volumes of Business Under Observation, Units	55,000	50,000	40,000 (*Standard Volume*)	30,000
Per cent of Standard Volume	137.5 Per cent.	125 Per cent.	100 Per cent.	75 Per cent.
Aggregate Mfg. Expense (Table 7)	$11,875,000	$11,250,000	$10,000,000	$8,750,000
Aggregate Commercial Expense (Table 10)	3,950,000	3,800,000	3,500,000	3,200,000
Aggregate Combined Expense	$15,825,000	$15,050,000	$13,500,000	$11,950,000
If the Expenses were Directly Proportionate to Volume, the Aggregate at the Indicated Volumes Would Be	18,562,500	16,875,000	13,500,000	10,125,000
The Difference Reflects the Non-controllable Character of the Expenses.	$2,737,500	$1,825,000	.....	$1,825,000
If This Difference be Divided by the Percentage Variance from Standard Volume, Which Is	37.5 Percent.	25 Per cent.	.....	25 Per cent.
The Amount of Non-controllable Expense is Indicated as	$7,300,000	$7,300,000	.....	$7,300,000

Thus there is a uniform indication of a total amount of expense which is independent of volume of business ("non-controllable expense") in the amount of $7,300,000. The cost of doing business, per unit of product or as a percentage of sales, will vary as between different volumes by reason of this non-controllable expense. Sales at standard volume are $50,000,000, so that the indicated non-controllable expense is 14.6 per cent of sales at standard volume. Net profits at standard volume are 13 per cent of net sales, so that the sales dollar at standard volume may be subdivided as in Table 14.

At a given selling price the combined total of non-controllable expense and net profit will remain constant as a percentage of sales. With sales below standard volume, the percentage of non-controllable expense will be proportionately higher and the percentage of net profit correspondingly lower, and *vice versa* with sales above standard volume. For example:

TABLE 14. SUBDIVISION OF THE SALES DOLLAR AT STANDARD VOLUME

Item	Per cent of Sales at Standard Volume
Non-controllable Expense, as Indicated Above	14.6
Net Profit, as Shown in Table 12	13.0
Combined Total	27.6
Variable Cost and Expense	72.4
Total Sales	100.00

With Sales at 137.5 per cent of Standard Volume,
Net Profit will equal 27.6 per cent $- \frac{14.6 \text{ per cent}}{1.375} = 16.98$ per cent of sales

With Sales at 125 per cent of Standard Volume,
Net Profit will equal 27.6 per cent $- \frac{14.6 \text{ per cent}}{1.25} = 15.92$ per cent of sales

With Sales at Standard Volume,
Net Profit will equal 27.6 per cent $- \frac{14.6 \text{ per cent}}{1.00} = 13.00$ per cent of sales

With Sales at 75 per cent of Standard Volume,
Net Profit will equal 27.6 per cent $- \frac{14.6 \text{ per cent}}{0.75} = 8.13$ per cent of sales

It will be noted that these profit percentages are in exact agreement with the figures shown in the summary tabulation, Table 15.

Return of Investment at Different Volumes. As the non-controllable expenses influence the profit margin, so the fixed portion of the investment influences the rate of return on capital. It is therefore not possible to compare directly the rate of return on capital actually realized or expected with the *economic return attainable*, since the latter represents an average rate of return to be realized over a period including both good and poor years, and is not the rate to be aimed at in a given year. In good years plants will operate at a rate in excess of *standard volume*, while in lean years they will operate at a lower rate. In years of high volume, the same *base price* will result in a rate of return on capital in excess of the *economic return attainable*, and in years of low volume in a rate of return smaller than the *economic return attainable*. Under the assumptions already employed, if operations were at the rate of 125 per cent of *standard volume*, the rate of return on capital at the *base price* would be 26.98 per cent, compared with 20 per cent at *standard volume*. On the other hand, if operations were curtailed to 75 per cent of *standard volume*, the rate of return would be only 10.84 per cent. It is essential, therefore, to be able to calculate readily the return on capital at different volumes of business at the *base price*: in other words, to determine what may be called the *standard return* at various

TABLE 15. PROFITS, CAPITAL EMPLOYED, AND RETURN ON CAPITAL

(At Four Different Volumes of Business)

ITEM	AMOUNT							
					Standard Volume			
Annual Sales, Units	55,000	.....	50,000	.....	40,000	.....	30,000	..
Net Selling Price Per Unit	$1,250	.....	$1,250	.....	$1,250	.....	$1,250	..
PROFIT AND LOSS STATEMENT:		*Ratio to Sales*		*Ratio to Sales*		*Ratio to Sales*		*Ratio to Sales*
Annual Sales, Amount	$68,750,000	1.000	$62,500,000	1.000	$50,000,000	1.000	$37,500,000	1.000
Factory Cost of Sales	55,000,000	0.800	50,000,000	0.800	40,000,000	0.800	30,000,000	0.800
Gross Factory Profit	13,750,000	0.200	12,500,000	0.200	10,000,000	0.200	7,500,000	0.200
Commercial Expense	3,950,000	0.0575	3,800,000	0.0608	3,500,000	0.0700	3,200,000	0.0853
Net Profit Before Application of Overabsorbed or Unabsorbed Burden	9,800,000	0.1425	8,700,000	0.1392	6,500,000	0.1300	4,300,000	0.1147
Overabsorbed Burden	1,875,000	0.0273	1,250,000	0.0200	.....	.....	.....	.....
Unabsorbed Burden	.....	.....	.....	.....	.....	.....	1,250,000	0.0200
Actual Net Profit	$11,675,000	0.1698	$9,950,000	0.1592	$6,500,000	0.1300	$3,050,000	0.0813
CAPITAL EMPLOYED:		*Ratio to Sales*		*Ratio to Sales*		*Ratio to Sales*		*Ratio to Sales*
Cash	$3,437,500	0.0500	$3,125,000	0.0500	$2,500,000	0.0500	$1,875,000	0.0500
Drafts and Accounts Receivable	6,875,000	0.1000	$6,250,000	0.1000	$5,000,000	0.1000	$3,750,000	0.1000
Raw Material and Work in Process	9,167,000	0.1333	8,333,000	0.1333	6,667,000	0.1333	5,000,000	0.1333
Finished Product	4,583,000	0.0667	4,167,000	0.0667	3,333,000	0.0667	2,500,000	0.0667
Gross Working Capital	$24,062,500	0.3500	$21,875,000	0.3500	$17,500,000	0.3500	$13,125,000	0.3500
Fixed Investment	15,000,000	0.2182	15,000,000	0.2400	15,000,000	0.3000	15,000,000	0.4000
Total Investment	$39,062,500	0.5682	$36,875,000	0.5900	$32,500,000	0.6500	$28,125,000	0.7500
RETURN ON CAPITAL EMPLOYED (annual rate), Per cent	29.89		26.98		20.00		10.84	

volumes with which actual or expected return may be compared.[1]

Summary Tabulation. The preceding Table 15, presents in summary form figures pertaining to profits, capital employed, and return on capital at the four different volumes of business previously considered.

Standards Subject to Examination and Modification

The standard ratios and percentages developed for price analysis should be compared currently with the actual ratios and percentages. Variations of actual figures from the standards are to be expected, and may result from one or more of a variety of cases, as for example:

1. Normal seasonal accumulation of finished product carried in stock.
2. Temporary lack of balance in productive inventories due to transportation tie-ups, machine breakdowns, or other causes.
3. Unusually heavy commercial expenses due to intensive sales campaigns.

These would constitute temporary variances and would not necessitate a revision of standards. On the other hand, variances might exist by reason of changes of permanent character, such as the following:

1. Increased fixed investment ratio due to the construction of additional plant for the purpose of manufacturing parts previously purchased from outside sources of supply.
2. Increased inventory ratio due to a change in policy with regard to carrying finished product in inventory, or to permanent changes in transportation conditions, or in relations with suppliers.

Such changes would require a revision of the related standards and should be anticipated when possible.

Since *standard volume* and *economic return attainable* play so important a part in the analysis of price, a continuing observation of all conditions involved in their determination is essential.

Price in Relation to Financial Control

While competitive conditions and other practical considerations ordinarily are the chief determinants of the price which shall be charged for a product, neverthe-

[1] Standard return on capital at any volume may be determined in the following manner:

Total non-controllable expenses plus profits, as a percentage of net sales at Standard Volume (annual basis) ..... = 27.6
Non-controllable expenses as a percentage of net sales at Standard Volume (annual basis) ..... = 14.6
Ratio of Working Capital to Net Sales (annual basis) ..... = 0.35
Ratio of Fixed Investment to net sales at Standard Volume (annual basis) ..... = 0.30

Let x = Ratio of assumed volume to Standard Volume

$$\text{Return on Capital at x volume} = \frac{27.6 - \frac{14.6}{x}}{0.35 + \frac{0.30}{x}}$$

For example, with a volume of 50,000 units per year, or 125 per cent of *standard volume*, x would be 1.25. The rate of return on capital at this volume would be

$$x = \frac{50,000}{40,000} = 1.25$$

$$\frac{27.6 - \frac{14.6}{1.25}}{0.35 + \frac{0.30}{1.25}} = \frac{27.6 - 11.68}{0.35 + 0.24} = 26.98 \text{ per cent}$$

The rate of return at any volume may be determined by this method; and for those volumes illustrated in Table 15 the results will be found to agree exactly with the rate of return shown in that table.

less comprehensive financial policies are necessary in business organizations which employ large amounts of capital. The pronouncement of a basic pricing policy, in terms of the *economic return attainable*, should be understandable *as a policy*, and should not be misapplied as a dictation of specific price. In other words, the impracticability of frequent adjustment of prices must be recognized, necessitating the maintenance of prices which at times may be above, and at other times below the *base price equivalent*. With due allowance for deviations of this nature, the method of price analysis affords a means not only of interpreting actual or proposed prices in relation to the established policy, but at the same time affords a practical demonstration as to whether the policy itself is sound. If the prevailing price of product is found to be at variance with the *base price equivalent*, other than to the extent due to temporary causes, it must follow that prices should be adjusted; or else, in the event of conditions being such that prices cannot be brought into line with the *base price equivalent*, the conclusion is necessarily drawn that the terms of the expressed policy must be modified.

It becomes apparent, therefore, that the analysis of price in accordance with the method outlined is closely interwoven with the matter of financial control, since the expression of price policy, in terms of rate of return attainable on capital employed, is the most significant factor bearing upon the question of availability of capital for purposes of operation.

Waste Reclamation in a Food Products Industry

Index Number
658.6571 Utilization of Waste

SINCE the subject of eliminating waste in industry has been receiving the attention of practical men some very important developments have been made along this line in many branches of manufacturing. In industries where competition was keen and selling prices, therefore, had to be low, the reclamation of waste products has meant the assurance of an ample profit, where before the margin was small.

In most cases, the new equipment developed has had to be simple in construction and easy to run, in order that its installation, maintenance, and operation might involve no costs that would wipe out the returns in prospect from the sale of by-products. In addition, it must be thoroughly practical and particularly suitable for the purpose in view.

A device has been developed on the Pacific coast, that meets these requirements for the canning industry, which have grown to large proportions in this section of the country.

A long-felt want in the modern green fruit cannery has been an apparatus that will clean the syrup solutions before they are sent to the syruping machines, and that will, in addition, enable the canner thoroughly to reclaim and clean the syrups that are lost at these machines. A large quantity of sugar syrup was spilled in the process of filling and closing the cans. The problem was to catch this syrup and put it through a simple clarifying system, which would be practical, and would not only pay for itself in a short time but also maintain a high quality of product.

In order to recover the values from the waste syrup, the sealing and syruping machines were equipped with catch pans. The syrup was then piped to a treating tank installed in the syrup room, and containing the necessary stirring and heating equipment. See Fig. 1. To this dirty syrup a specified amount of specially prepared filter medium is added, and when the syrup is properly treated, it is pumped through a filter press and into the regular syrup lines, or to the special storage tank contained in the apparatus.

At a San Jose cannery, one line (most canneries have 10 or more lines) consisting of a syruper and closing machine, showed a waste of 50 gals. of 40 deg. syrup per day, which is now reclaimed by the new process.

The process when in operation works very simply. The attention of one man, usually the sugar-room foreman, for part of an hour each day, is sufficient to handle the waste syrup. The equipment removes all dirt, oil, and foreign matter, treating 200 gals. of syrup per hr. The clarified syrup is guaranteed to conform to all pure food requirements.

In the case of new syrup, the process is much simpler. The same apparatus which is installed in the syrup room is connected with the cannery syrup-mixing tank. A return pipe from the machine is placed so that different degrees of syrups can be returned to their respective tanks. The equipment removes all suspended matter, and handles 1000 gals. per hr.

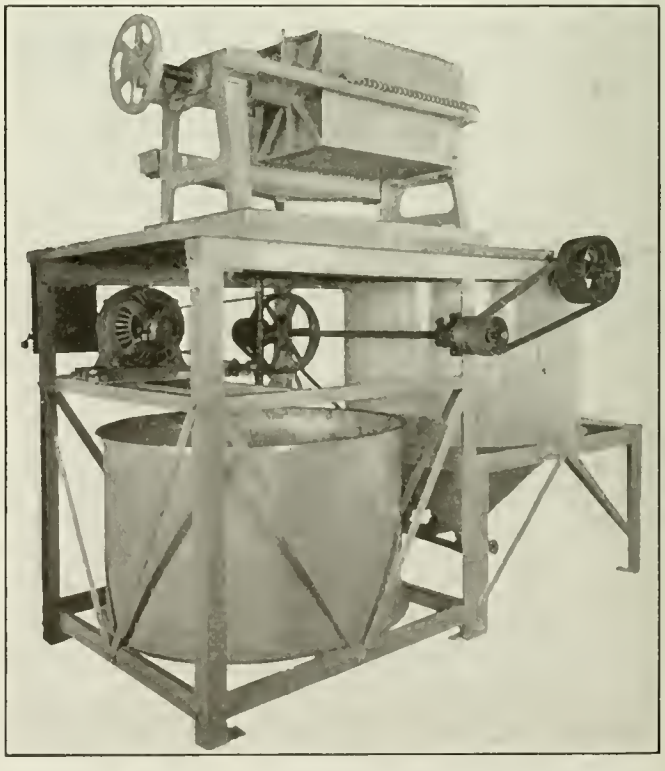

FIG. 1 APPARATUS FOR RECLAIMING AND CLEANING USED SUGAR SOLUTIONS

Factors Affecting Wages and Other Shares in the Product of Industry

III—Economic Problems of Industrial Organization

By FREDERICK C. MILLS

Associate Professor of Business Statistics, Columbia University

Index Number
338 Production
331.2 Wages

COUNTLESS industrial disputes center about the question of wages. To the worker it is the central problem of existence. To the employer it is the question which affects his business so vitally that unless it can be satisfactorily settled his enterprise cannot endure. The stimulus to the development of labor organizations and employers' organizations has been given by the problem of wages. It is a problem which lies at the heart of much of the economic unrest of the day.

The Wage Problem a Phase of the Problem of Distribution

Many efforts have been made to develop a scientific method of wage determination, a method which shall be rigorously exact and unaffected by human judgment, but no such method has been perfected. The central weakness in such efforts is that they attempt to isolate the question of wages, to consider it apart from the larger question of the division of the product of industry, and to ignore the major economic factors which enter into this division. The elements in this problem have been suggested in an earlier article.[1] There are four co-operating factors in production, and the product of the industries of a country represents the joint effort of labor and business enterprise using capital to exploit natural resources. The joint product, in terms of wheat, coal, potatoes, beefsteak, etc., is divided into four parts, which we call wages, profits, interest, and rent. Use is made of the price system in effecting this division, but fundamentally it is a division of material products which satisfy human wants. Since it is a *sharing* process, the adequacy or the fairness of one part cannot be determined apart from the size of the other shares. When one is faced with the problem of dividing a pie some principle of division must enter, a principle which takes account of the relative size of each of the shares. The recipient of any one piece will naturally cast eyes upon the other pieces, and will judge of the adequacy of his own share only in its relation to the other shares. None of the proponents of the so-called scientific wage systems (excluding certain profit-sharing enterprises) has attacked the wage problem as one which must be viewed relatively. Those who have tried to adjust wages by compulsory arbitration have found that what constitutes a *fair wage* cannot be determined unless one is prepared to decide what constitutes *fair profits, fair interest,* and *fair rent.* Thus the problem of wages is merely a phase of the problem of *distribution,* the term used to designate the process of dividing the joint products into the shares enumerated. (This meaning of distribution is not to be confused with that current usage in which it is synonymous with marketing.)

Before discussing the factors which enter into the problem of distribution certain considerations of paramount importance in connection with this problem should be noted. We may conceive of many different principles upon which the joint product of industry might be divided—principles based upon conditions varying all the way from chattel slavery to communism—but unless three primary requirements are met the economic system and the culture dependent upon it are doomed. They may flourish temporarily but, unless these conditions be fulfilled, they cannot survive under modern conditions.

First and most important is the welfare of labor. Material comforts in the way of food, clothing, and shelter, together with educational opportunities for the great mass of workers of a nation, constitute a prior lien upon the product of industry. An efficient and enduring economic system is impossible unless these claims be met. A civilization based upon a denial of these things cannot endure, for its material foundation will fail.

Another Fundamental Requirement

A second fundamental requirement is that the product of industry be so disposed and labor so directed that the capital equipment—the tools, machines, railroads, factories, surplus food supplies—be fully maintained, and increased and improved as population needs and the march of invention warrant. It needs no argument to demonstrate that modern populations cannot survive unless the material equipment of industry be kept up. In order that this be done it is essential that a certain proportion of the labor of society be devoted to the production of this equipment. This necessitates the production of a surplus of consumable goods which may be used to support workers engaged in the manufacture of capital equipment. Using the counters with which men calculate under the price system, this means that part of the money income of the mass of income recipients must be *saved* and *invested.* The process of investment is one by which control of the goods which

[1] See MANAGEMENT AND ADMINISTRATION, February 1924, p. 215.

this surplus money income represents is handed over to the borrower—the railroad, steel mill, or textile factory. The goods are then used by this borrower to support labor employed in replacing or adding to its material equipment, its *capital* in the true sense of that word. The principle upon which the process of distribution is based must be one which permits and encourages the saving which eventuates as capital equipment.

Economic Productivity

The third requirement is that the division of the product of industry be performed in such a way that the productivity of the economic system is not impaired. This involves the two considerations first mentioned, but includes other factors which need not be detailed here. If a nation's economic product is so apportioned that incentive to labor and to leadership is lacking, that initiative is lost, or that the productive efficiency of the system is adversely affected in any other way, the process of division is based upon faulty principles. Industrial productivity is by no means the sole requirement of our economic system, nor the most important, when human values are in question, but the attainment of other ends and the satisfaction of other requirements are conditioned by the degree of productive efficiency attained.

With these considerations in mind, the factors which affect the remuneration of labor and of the other agents of production may be briefly outlined. These factors are of two general types—those which affect the amount to be divided and those which affect the process of division itself. The first class includes all factors which affect the total volume of production, for the real rewards of labor, in terms of material goods, depend in the last analysis upon the amount of consumable wealth produced. The Patagonian and Eskimo live upon lower economic planes than the average American primarily because of differences in the volume of goods produced, not because of differences in social structure, legal system, or method of dividing the product. The well-being of the mass of a nation's citizens depends, of course, upon the way in which the national product is divided, but it depends more immediately upon the total volume of goods available for division.

Influence of Production on Wages

The factors which influence the volume of production have been outlined in an earlier article.[2] Therein the dependence of production upon the efficient use of natural resources, upon the character and training of the population, upon adequate capital equipment and upon efficient industrial leadership was pointed out. It may appear that these factors have but a remote and uncertain bearing upon the central problem now under consideration, that of wages, in relation to the other shares in distribution. Yet the factors named are of major and immediate importance, neglected though they often are in the discussion of wages. For these determine the size of the pie to be divided—the number of bushels of wheat, potatoes, and corn, tons of coal and pounds of beef, yards of cloth and gallons of gasoline which make up the annual real income of an economic group.

Bearing in mind the importance of those factors which affect the size of the total product which is to be divided, the forces which affect the process of division itself may be briefly considered. Many general theories purporting to explain the process of distribution have been advanced, but it may be questioned whether any one general explanation is of universal validity. The process by which the material goods produced by society are divided among all who have co-operated directly or indirectly in their production is a highly involved one, complicated by the fact that the return any one individual receives may consist of several different shares (as a farmer may in his own person receive wages, interest, profits, and rent), and doubly complicated by the fact that it is carried on behind the screen of prices, behind monetary returns. While no one theory may describe the process, an explanation of certain of the forces at work may at least clarify the problem.

The Rôle of Business Enterprise in Distribution

It is the business leader, the organizing factor in production, through whose hands the actual process of distribution takes place. When the division of function in production is simple and perfectly clear-cut we have the organizer renting land, borrowing capital (strictly, he borrows the money which gives command over capital goods), hiring manual labor, a clerical force and his executive officers, paying these various agencies out of his proceeds and keeping the balance for himself. To the landowner he pays *rent,* for the use of capital he pays *interest,* for the services of labor *wages* (including salaries) while his own share constitutes profits. (If the enterpriser is not an individual but a corporation, the profits, when apportioned, appear as *dividends.*) The question, What determines the relative sizes of these shares? is equivalent to, What determines how much the enterpriser shall pay these various agents and how much he shall keep for himself?

To the business man himself this is merely a problem in buying and selling. He pays for the use of land an amount fixed by the competition of the market, with regard to the quality and location of the given site. He borrows capital at the market rate of interest, and hires labor at prevailing wage rates. He may shade the market rates a little by astute bargaining, but essentially the market guides him. Any explanation, therefore, must go back of the market to the forces determining the market rates for these various agents. A detailed account of the forces at work in a given case is not possible here, even if knowledge of all such details were to be had. The present discussion must be confined to the factors which are peculiar and unique in affecting the play of competition in the case of each agent.

The amount secured by the owner of any particular piece of land depends upon the relative advantage for a given purpose, which the utilization of that property conveys. In the case of land it is a *differential advan-*

[2] See MANAGEMENT AND ADMINISTRATION for February 1924, p. 215.

tage for which a price is paid, an advantage which one site possesses over others. This differential advantage may be due to a favorable location, as in the case of a retail trading site, fertility, in the case of agricultural land, or richness, in the case of a mine. It is because a given amount of labor will produce more on one site than on others that rent will be paid for its use. It follows that rents shade off, as the degree of advantage diminishes, until "no rent" land is reached, land for the use of which nothing will be paid. Rent, then, represents a share in distribution paid for the use of property in the form of natural resources, and its amount, in the case of a given site, depends upon the relative advantage resulting from the use of that site. Through competition the amount actually received for its use tends to approach the full value of this differential advantage, though the money rental may frequently be less than the full *economic rent* which might be exacted. As population increases and the available land is more fully occupied, rents rise, and the no-rent limit is pushed farther and farther out.

The Rate of Interest

Interest, like rent, represents a payment for the use of property, but in this case the property is that which has been produced by man. The actual rate of interest prevailing at a given time is determined by the play of competition between borrowers and lenders of capital, the bids of the former being influenced by the amount they can gain from the use of additional increments of capital for specific purposes. As the *productivity* of capital thus lies back of the demand for it, so the fact that the accumulation of capital involves *abstinence*, at least for some savers, limits the amount accumulated. This limitation is obviously an important factor, from the side of supply, in determining the market rate of interest. New inventions, increasing the productivity of capital, tend to raise the rate of interest, while the constant accumulation of new capital tends to lower it. The net result has been a steady but slow decline in the interest rate, a decline which was interrupted by the great destruction of capital during the world war.

Non-Competing Groups in Relation to Wages

The share of labor in the total annual production of economic goods is determined by general market forces similar to those described above, but here again a number of conditions affecting only this particular problem are met with. A distinct and peculiar characteristic of labor is found in the existence of non-competing groups. The capital which is available for investment, which is represented by funds in liquid form, may be looked upon as homogeneous. The investor may buy a railroad bond or a steel bond, may lend to a telephone company or textile mill. All are competing for his funds, and in the market a uniform rate will be fixed for investments of the same general strength. Not so in the labor market. Bank clerks do not compete with bricklayers, bookkeepers with carpenters, engineers with coal heavers. The forces of competition play in determining wage rates, but they play within circumscribed regions, determining many rates, not one common rate with minor variations. The peculiarities of the labor market cannot be understood without a recognition of the existence of these more or less distinct compartments.

No final classification of these non-competing groups is possible, for no clear-cut and definite lines of cleavage may be drawn. The following division, representing very real lines of economic difference, has been suggested. Smaller groups might be set up within each class, if minor wage differences were of interest. The five fundamental groups, set off from each other by differences of education and training, other environmental differences and, to some extent, by differences of inborn gifts, are the following:

1. Unskilled manual laborers.
2. Semiskilled manual workers.
3. Skilled manual workers.
4. Clerical workers.
5. Salaried business managers.

The list is not designed to include independent professional men, nor independent business organizers who draw their main reward from profits.

Within each of these groups wages, in the broad meaning of that term, tend to a rough equality. In certain of the higher groups there may be very marked differences but these do not destroy the significance of the general classification. Differences within a group tend to disappear as superior rewards attract men from other occupations in the same class, or change the direction in which rising generations are led. The adjustment is slow, and never perfect, but it is much more marked within each group than between groups. The differences between groups tend to be fixed and constant, though particular individuals may cross the economic boundaries between groups.

The Determination of Wages

The immediate problem is: What determines the wage received by an individual within any one of these groups? The answer in general terms is as follows: The common wage within any group is fixed by the play of competition between two limits. The lower limit is set by the standard of living, a standard which may correspond with that of bare physical subsistence for certain groups at certain times. If wages fall below this limit men and women will not marry, the group will not be perpetuated, and obviously the wage level will not be a permanent one. The standard which is accepted as permitting marriage and the raising of a family is, of course, much higher for some groups than for others. The lower limit, then, is set by what the workers in a given group will accept, and which will permit the perpetuation of the group. The upper limit is determined by the degree of indispensability of labor in a given group, to use an awkward but suggestive term.

If the services of an individual in any group are relatively indispensable, because of high productive capacity, limited number of equally capable workers, or intensity of demand for the given product, that

individual, in common with all the other members of the given group of equal capacity, is in a position to demand a high wage. He may demand as much as the employer would lose if a single individual in that group were to leave. If a wage were to exceed this amount an employer would reduce his working force and the resulting competition of labor would reduce wages. But he will not pay up to this limit, the limit fixed by the full contribution of a single laborer in his force, unless forced to. The actual rate of wages is fixed between these two limits by the relative bargaining power of employer and employees. Bargaining power is affected by such a multiplicity of factors —business conditions, amount of unemployment, degree of organization of workers and employers, etc.— that no discussion of this subject can be attempted.

The Rent Element in Wages

In the preceding discussion equality of ability within each group has been assumed, for the purpose of simplifying the argument. Such an assumption is not erroneous, in so far as the determination of a basic wage rate for each group is concerned. In practice, however, there are many variations from the basic group, variations due to individual differences. These differences are quite analogous to those differences between plots of land which gave rise to rent, and hence there exists what is called a "rent element" in wages. The men of exceptional ability will command a return above the standard, just as a particularly favorable site will yield an exceptional return. Such differences of ability, however, do not by themselves explain how wages are determined; the effects of such differences are merely superimposed upon the effects of the forces described above which determine the basic rate of wages in a given group.

This account of the factors affecting wages necessarily lacks the definite and exact appearance which the so-called "scientific" wage systems possess, but in that respect is truer to life than they. There is no one theoretically just and correct wage. What we actually have under the present system is a struggle for the product of industry. The share each factor gets depends upon its strategic position, in a bargaining sense, and its reward varies consequently from time to time and from place to place as the conditions affecting this strategic power vary. This is notably true in the case of labor. In the determination of wages, however, this struggle is conditioned by the existence of fairly definite upper and lower limits to the fluctuations of wages.

Competitive and Monopoly Profits

The factors determining the amounts which the business organizer must pay for the services of the other agents of production have been briefly described. These payments having been made, the remainder, if there is any, constitutes profits. Profits are thus a residual share and may be expected to vary much more widely than the other shares. Under very favorable conditions they may be exceptionally large, and they may fall below zero when the conditions are adverse. The factors affecting profits are numerous—the degree of risk undertaken, exceptional individual efficiency, monopolistic advantages, or temporarily favorable conditions which may be due to any one of a number of causes.

The distinction between profits which rest upon permanent or semi-permanent conditions of a monopolistic nature, such as the control of a secret process or of a patent, and those which arise from advantages which are only of a temporary nature is an important one. The latter are termed *competitive profits*, and their characteristic feature is a tendency to disappear under the pressure of competition. If ever a thoroughly static economic condition were attained there would be no profits of this type. Business managers would secure a reward for their labor only, and nothing in addition. But in a system characterized by constant change—new inventions, new industrial processes, new business methods—opportunities for competitive profits are always open. Such profits possess a Protean elusiveness; they are ever tending to disappear, but ever present in new forms. Profits derived from monopolistic advantages, on the other hand, are not subject to the encroachments of competition. As long as the advantage remains the profits are certain.

Conclusion

The aim of this discussion has been to present the general background of the problem of distribution, to describe briefly the nature of the forces which affect the division of the product of industry, and to indicate the importance of certain basic requirements. The nature of the wage problem can only be understood when these general factors and forces are borne in mind. It has been emphasized that the absolute size of any one share in the division of the pie depends upon the size of the original product as well as upon the size of each of the other shares. If one share grows at the expense of others to the point where future pies are reduced in size the gain may be purely illusory, and this fact must be recognized in the process of division.

The welfare of labor must be a dominant consideration in this partition of the product of industry, but due regard to this welfare compels attention to the maintenance of the capital equipment of society and to the preservation of conditions which will insure the full productivity of the economic system.

(To be continued in the May issue.)

THIS is the third article of a series on the "Economic Problems of Industrial Organization". Previous instalments have dealt with "The Factors of Production," and "The Industrial System and the Price System". The fourth and final section, to appear in the May number, will discuss the foreign trade of the United States in relation to domestic economic problems. Each article has presented pertinent factors entering into important phases of industry, with the object of explaining, in a practical way, how the fundamentals of economics can be applied to the basic policies of business operation.—THE EDITORS.

Organization of the Accounting Division

A Co-ordinated System of Planning, Routing, Cost Accounting

By FREDERICK A. WALDRON

Consulting Engineer

Index Number

658.5:657 Shop accounting

IN developing a co-ordinated system of control let us assume we now have an organization which, in so far as the physical production of an article is concerned, is complete. It very soon develops, however, that certain information is required as to how much this product is costing, which naturally requires information as to where and how efficiently money for this work is spent.

So we find that in order to know "where we are at" financially, records of costs and disbursement of money are necessary. In order to obtain this, the accounting division comes into existence and has full control of the classification of all receipts, expenditures, and charges incident to the operating of all divisions. An outline of the organization of such a division is shown in Fig. 26. An accounting method which gives accurate results must be simple and direct with as few clerical transferences of original data or figures as possible. It should also fit in and become part of the production control in order that the greatest economy can be attained. The object of the method presented in these articles[1] is first to symbolize the accounting method to give the most direct information with the minimum of clerical labor. This is accomplished by the use of the following forms: Time tickets, pay-roll, analysis sheet, requisition on stores, worked materials requisition. These will be taken up in the order named to show their relative places in the system.

The time ticket, Fig. 27, absolutely controls classification, amount paid, and work done, together with the time a machine is operated upon the work. The items and their arrangement on the card are shown in the accompanying illustration.

This original information is segregated in eight different ways, according to the use to which it is to be put, as follows:

1. For posting the route card.
2. Making up pay-roll.
3. Average hourly earnings.
4. Average piece-rate earnings.
5. Machine hours.
6. Lot costs.
7. Part or group costs.
8. Total costs.

This operation is done by means of assorting trays which can be utilized for divisions, groups, sections, parts, or operations. See Fig. 28.

Pay-roll

The pay-roll is made up on a general form similar to Fig. 29. It contains division disbursement by symbol or order numbers, all of which are ultimately transferred to the analysis sheet. The pay-roll is made up directly from the time tickets, the process of which is shown by the items listed in Fig. 27.

In order that a Ledger account may

[1] See MANAGEMENT AND ADMINISTRATION, January 1924, p. 39; February 1924, p. 173; March 1924, p. 295, for previous articles describing the principles of this system.

TREASURER OR COMPTROLLER
WORKS MANAGER
ACCOUNTING DIVISION

Overhead	Purchases	Stores Records	Time and Pay-Roll	Costs	Analysis Sheets	Earnings Records
Classification Allocation Supervision	Debits Credits Returned Goods	Stock Cards Worked Materials Cards Requisition Cards Prices Maximum and Minimum Inventory	General Supervision Checking Signatures Employees Receipts Clearance Slips Making up	Operation Parts Lots Groups Sections Division Finished Product Materials Authorizations Machines	Entries: (a) Labor (b) Materials (c) Debits (d) Credits (e) Inventories (f) Closures (g) Symbols (h) Special Orders (i) Authorizations	Workman Hours Piece Rate Hours Machine Hours Tool Makers Hours Pattern Makers Hours Laborers and Other Help

This Division should be prepared to furnish at short notice all figures vital to economic production.
Corporate Books are not kept by this Division but are under the direct control of the Treasurer or Comptroller.

FIG. 26 FUNCTIONAL OUTLINE OF THE WORK OF THE ACCOUNTING DIVISION

be kept for all factory activities, the analysis sheet (Fig. 32) is provided, one sheet being assigned to each symbol of the symbol chart.

Analysis sheets should also be made out for "worked materials and stores". Each of these sheets carries a debit and credit column in which all debits and credits are entered as they occur. These accounts can be closed in to the Profit and Loss and Capital accounts at such periods as may be determined.

EMPLOYE NO.			
SYMBOLS		NUMBERS	
GROUP		LOT	
SEC		PART	
DIV.		OP'N	
DEPT.		M'C'H	
TIME CARD	DAY WORK	NO. P'C'S	
		SP'L'D	
FINISHED		NOT FINISHED	
RETURNED			
ISSUED			
TIME			
RATE			
WORKMAN'S NAME		AMT.	
FOREMAN O. K.			

FIG. 27 TIME TICKET FORM (5 x 3 IN.)

Requisition on Stores

It is quite neeessary to have an accurate account of all materials used in production as well as the essential materials used for Betterment and Expense accounts. In order that this may be under absolute control, Fig. 30, known as "Requisition on Stores," is used for all materials which are issued by the stores for the above purpose.

Care should be taken in making out these requisitions as well as the pricing and the extending of the amounts involved on each requisition together with the account or symbol number.

The requisition should state the exact amount of materials required for a given purpose. As the work passes through the shop and spoilage occurs, requisitions should be made out to replace the spoiled work and charged to the classification prefixed by a special number or symbol indicating that it is for the replacing of spoiled work. By the use of the part and lot number, this requisition will find its way to the proper place in the stock department and automatically appear as either a part of the cost of producing or as an expense incident to the production.

If the replacement of the part spoiled is charged directly to the part number with a prefixed symbol indicating the replacement, it automatically appears as a portion of the flat cost of the article. On the other hand, if it is charged to the proper classification with an expense number prefixed, it automatically enters through the analysis sheet as part of the overhead and a particular classification.

Care should be taken in the handling of these requisitions to avoid a double burden or charge especially in the final closure of the analysis sheet.

Worked Materials Requisitions

The handling of worked materials requisitions is rather more complex and involved than the stores requisition. Worked materials as they appear in store should be valued at the flat labor cost plus the necessary overhead to bring them to the state of completion that exists when delivered to the worked materials section of the storeroom. (See Fig. 31.)

As this element of cost has already been taken care of by the requisition on stores and the time ticket, the debit and credit of worked materials on the analysis sheet is a process which only affects the status of the books at the time of closure or periodic financial statements.

For parts spoiled or lost in assembling, the same treatment should be given to worked materials requisitions as is used for "Requisition on Stores".

Care should be taken in the treatment of the inventory of worked materials, and it should appear only as a shop credit or debit at the time of such closures or financial statements, as an offset to the expenditures involved in production.

Where worked materials are transferred from one specific classification to another, a debit and credit should be established on the analysis sheet of these classifications. To illustrate, department A requires worked materials from department B amounting to $50 in value. This $50 should be debited on the department B analysis sheet and credited on department A analysis sheet. The above is intended to outline an illustration of the principles involved, and the works manager will be called upon at different times to determine what course shall be pursued in the specific case brought to his attention.

Betterments

One of the most perplexing elements of shop accounting is the treatment of betterments. The Betterment account is an account established for the purpose of recording expense involved in the production of those elements on which there may be a question as to the proper value of such elements and a reasonable doubt as to what proportion should be charged to the Capital account and what proportion to Expense.

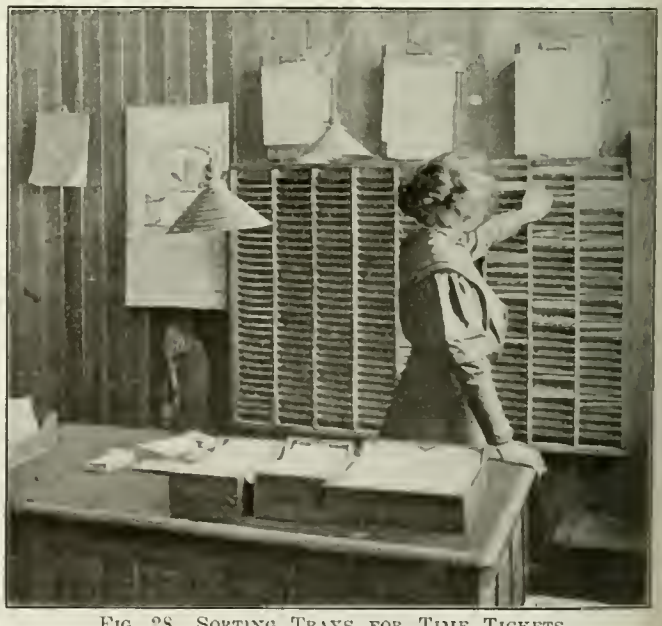

FIG. 28 SORTING TRAYS FOR TIME TICKETS

All authorizations or budgets initiated and issued carry with them at the time of issue a question of permanent or temporary value. When the books are closed at the end of the year the betterment accounts should

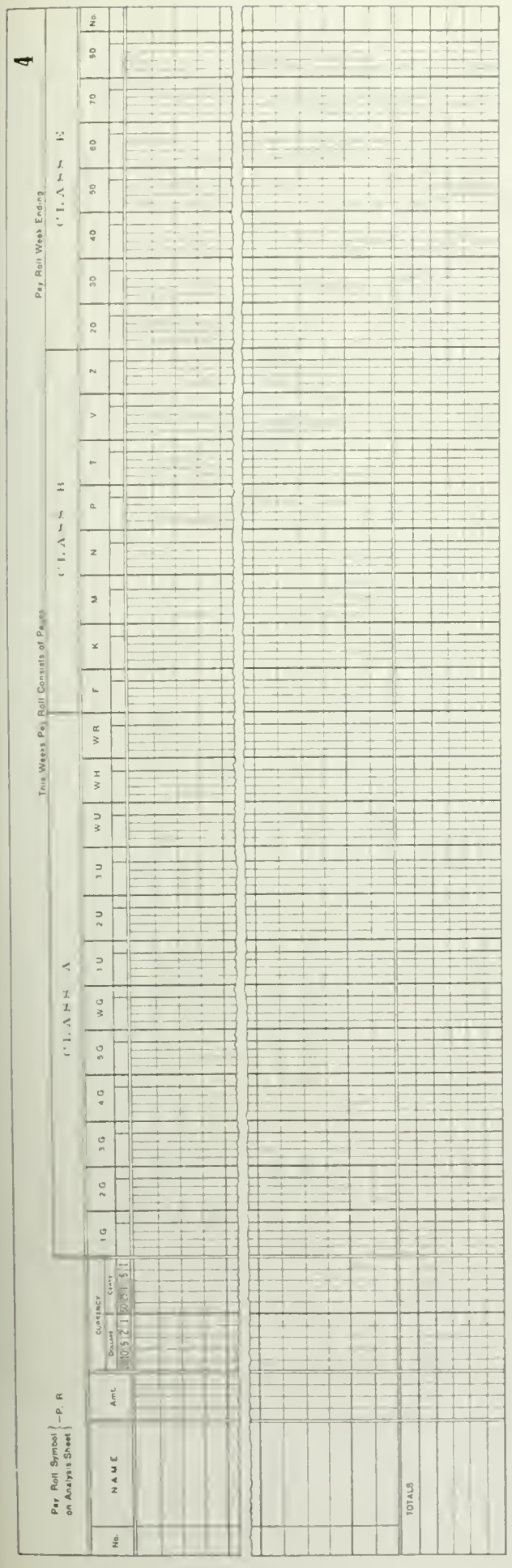

FIG. 29 PAY-ROLL FORM CONTAINING DIVISION DISBURSEMENT BY SYMBOL OR ORDER NUMBERS

be treated conservatively. The following example will establish the principles involved in this treatment.

Let us assume that authorization No. 20 calls for the manufacture of a completed set of tools for producing a lawn-mower which at the time has apparently great possibilities. These tools are made during the first six months of the year and the lawn-mowers are completed and placed on the market. The sales are disappointing, so much so that it is decided to dispose of the stock on hand and discontinue future production.

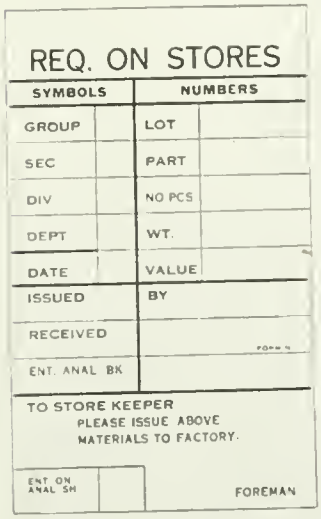

FIG. 30 STORES REQUISITION FORM (5 x 3 IN.)

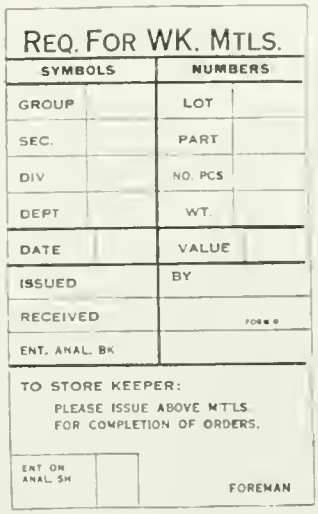

FIG. 31 WORKED MATERIALS REQUISITION FORM (5 x 3 IN.)

At the close of the fiscal year this authorization is examined and the value of the tools compared with the profits and marketability of the product which in this particular case is nil. The inevitable result is to charge 100 per cent of the tools and fixtures to expense.

As the reverse of the above, let us assume that tools and fixtures are authorized for a coffee grinder and it proves to be an excellent seller with good profits and indications of a large demand in the future. At the close of the fiscal year it would be quite proper in this case to charge the tools and fixtures to the Capital account less a reasonable depreciation for the time they have been in use.

This depreciation can be either a constant percentage for the ensuing year or it can be depreciated by the sliding scale increasing the percentage gradually each year until the value has been wiped out.

It should be borne in mind, however, that only the original value less its annual depreciation should be taken into account and any repairs or replacements of these tools and fixtures should be charged to an expense unless the replacement involves more elaborate and expensive equipment than the original article produced, in which case a portion can be added to the Capital account and a portion to Expense.

It is an easy matter to conduct an accounting system which will give a reasonably correct figure for the flat cost of all labor and materials.

The chief value of a shop accounting system, however, is so to classify expenditures that each portion of the product is carrying its proper share of the burden. So great has this burden become in the

PAY ROLL P. R.
PUR. LEDGER P. L.
SALES LEDGER S. L.
WORKED MTLS. W M
STORES ST.

ANALYSIS SHEET

Dr.

Close Into

Acct.

Cr.

DATE	ACCT	ITEM	LABOR	MATERIAL	TOTAL	DATE	ACCT.	ITEM			TOTAL

FIG. 32 ANALYSIS SHEET FORM FOR WORKED MATERIALS AND STORES

FIG. 33 PRODUCTION CLERK'S OFFICE WHERE ALL TIME CARDS ARE GIVEN OUT AND CLOCK STAMPED

FIG. 34 PAY-ROLL OFFICE WHERE PAY-ROLL IS MADE UP, TOTALED, AND ENTERED ON THE PAY-ROLL RECORD

modern industry that it ranges from 100 to 350 per cent of the flat labor expended for the initial processes of complete manufacture.

Too much stress cannot be placed on the facilities for use in this division. These are as essential for quick, accurate work, as jigs and fixtures are for the producing division or gages for the inspection division.

Time clocks, adding machines, assorting trays, and special desks and rubber stamps are all important as well as their arrangement. (See Figs. 33 and 34.) When from 60 to 80 per cent of the time of the average clerical force is spent in handling papers, and the remainder of the time spent on work required to complete them, the importance of these appliances can be fully appreciated.

It is better to adhere to a few principles and have these accurate than to try and obtain complicated and oftentimes unnecessary information.

If the original of any transaction contains sufficient data when made out, classification of any kind can be quickly acquired by the use of assorting trays properly designed and arranged. (Fig. 28.) With a good adding machine, all data necessary to guide the manager can be readily obtained at small expense, if desired. If it is not desired, the expense is not incurred.

Office Employees and Entrances

ONE company administers its office building on the very modern principle that all employees are alike, from the office boys and clerks to the president, and therefore that there shall be no rules for clerks as distinguished from officials, even in regard to what entrances shall be used by the clerks. Any employee is quite free to leave or enter by the main front door if he or she desires, or if it is the quickest way in their direction. This liberty is taken advantage of mostly in summer, when the girls come without hats or coats and are through the doorway in a twinkling, so that they do not block traffic to visitors. In cold weather, however, this use of the front entrance might be a most serious obstacle.

Hence the coatrooms are located directly inside the side entrances of the office building in the basement. Employees find it most convenient to use these doorways in order to reach the coatrooms when arriving in the morning and at noon. Since access to the street from the locker-rooms is easiest from these side entrances, workers have no tendency to use the main doorway for exit. In this manner the front corridor is kept free from a great deal of the traffic and outsiders can come and go at any time without inconvenience. The effect upon visitors who arrive around opening or closing time is very favorable.

A paragraph in a little booklet issued to all employees at the time they are hired calls their attention directly to this: "The side entrances are convenient to the coat rooms. By using these side entrances generally, we leave the front entrance free from congestion to our many callers". This gets the desired effect, without losing the atmosphere of friendly equality.

Time Study and Standardization

III—Profitable Methods for the Small Factory*

By GEOFFREY C. BROWN

Chief Engineer, Jacques Kahn, Inc.

Index Number
658.5421 Time study
658.516 Standardization
658.16 Organization

IN exactly the degree that industrial operations may be referred to an established set of models or standards, so are they susceptible to wise direction, and without such standards there can be little direction. Industrial concerns, large and small alike, should therefore be in possession of standards for all their work—operating and output standards, standards of quality of product, merchandizing and wage standards, and standards of ethics and discipline. Inasmuch as these standards must provide all of the guidance for present and future planning, it is highly desirable that they be made as comprehensive as possible, and that they be clearly recorded for constant and convenient references.

Much past industrial strife is traceable either directly or indirectly to the absence of an intelligent, prevailing relationship between output and wages, and to the lack of any sort of an established standard controlling either. But many changes have taken place since the epoch of the first half of the nineteenth century. Two of these stand out with special prominence as featuring the transformed industrial attitude of today.

First, there has been a gradual relinquishment of the economic doctrine of "laissez-faire"—that complacent tenet, which accepted industrial oppression as a necessary and unavoidable by-product of the competitive system. The second, an evolutionary change of first importance in the scope of these articles, lies in the application of the scientific or engineering method to the management problems of industry.

Abandonment of the laissez-faire attitude is manifest in a more or less general recognition throughout industry that the responsibility of management does not end with the payment of a stipulated wage in return for service rendered, but that it must include, also, measures for the safety and welfare of all the workers, together with a reasonable participation in the prosperity of the enterprise for all those who, by loyalty and efficient work, have contributed to its success. The application of engineering methods to industrial management aims at the acquisition, by scientific investigation, of accurate knowledge as to how industrial operations may be most efficiently and economically performed; the assembly of this information in the form of written standards; the utilization of these standards as an efficient basis for conducting all present and future operations, including the payment of wages; and the frequent revision of existing standards, whenever a new development renders such a revision desirable.

The practice of establishing, by means of stop-watch observation and subsequent time analysis, proper output standards for manufacturing operations, is applicable where the output of individuals or groups may be conveniently measured with relation to time. The latter characteristic necessarily excludes certain functions and certain classes of work. It is extremely difficult, for instance, to measure management and "managerial" output, although some progress has recently been made in this direction. The preponderance of manufacturing operations, however, may be readily analyzed in relation to time, and in the standardization of this class, time study, when properly utilized, proves an invaluable aid to management.

The specific ends accomplished by time study within its field, may be listed somewhat as follows:

1. To reveal inefficiencies in the performance of operations.
2. To establish and standardize conditions favorable to efficient operation.
3. To establish standard unit times for the performance of work.
4. To establish standard output figures.
5. To establish a basis for the determination of standard operation costs.
6. To provide a basis for standard piece-work or bonus rates.

An examination of this list shows the words "standard" or "standardize" occurring in every item but the first, which is of a preliminary character to those that follow. The general purpose of time study may therefore be simply conveyed by defining it as "*An instrument for use in establishing, recording, and maintaining efficient, standard practice.*"

Time Study in the Small Factory

The application of time study in the small factory is considerably facilitated by the mutual understanding that either exists, or may be readily established, between its management and working force. Here the works manager or superintendent is personally acquainted with most of the workmen. He is on familiar terms with the older hands, and as he passes through the shop, frequently pauses to extend a friendly greeting or to discuss important details of the work with them. This gives the workman an inner knowledge of the concern's affairs, and produces an atmosphere of

*Preceding articles have appeared in MANAGEMENT AND ADMINISTRATION, February 1924, p. 161; March 1924, p. 305.

domesticity that has no parallel in the large organization. The inauguration of time study, if it is an innovation, at once arouses lively curiosity throughout the small plant, and the workmen are not satisfied until they thoroughly comprehend its general purpose. If the management meets this inquiry in a spirit of frankness, laying tactful emphasis on the fact that any increase in productive efficiency will conduce mutually to the greater prosperity of both the concern and the workmen, there will be little difficulty in securing the sympathy and co-operation of the latter, without which time study must perforce be conducted at a serious disadvantage.

This spirit of frankness and open dealing is now accepted as an essential characteristic of successful management, and attempts at secretiveness in the observation of workmen have no place in modern methods.[1] As R. W. Darnell aptly states it: "... the day of gumshoe time-study is past". The greatest measure of success will be obtained by a tactful enlightenment of operatives, not only as to the purpose of the time study, but also as to its manner of procedure.

It is important that these features be emphasized in a consideration of the small factory, on account of the rapidity with which its working force reacts to characteristics of managerial policy. It may be truly said that in a small plant the beneficial results of a wise policy appear overnight, and the ill effects of a mistaken one, manifest themselves with similar speed.

Time-Study Procedure

The initial step in time-study procedure consists of the selection of some one who, by training and experience, is fitted to go into the factory and record intelligent time analyses on manufacturing operations. In an earlier article, the specific duties pertaining to this function were set forth about as follows:[2]

> The time-study man records stop-watch observations on manufacturing operations, checks up [and, if necessary, corrects] speeds and feeds of mechanical equipment, compiles standard output figures, computes piece-work and bonus rates, assigns tasks, and develops standard practice instruction cards.

In the small plant where planning functions are necessarily distributed over a limited staff, it will sometimes be found advisable to include as an additional requisite, the preparation of whatever drawings and blue-prints are necessary to manufacture. A good time-study observer is therefore one possessed of a high school education, or its equivalent, supplemented by a course in mechanical drawing. He should have an extensive experience, and be able, if necessary, to operate any machine in the factory, as occasions will doubtless arise when he must demonstrate the reasonableness of an assigned task, for the benefit of incredulous workmen. In addition to these qualifications, a time-study observer should possess an even temper, a fund of patience, and the gift of diplomacy in his dealings with foremen and workmen.

We will assume that an observer possessing these qualifications has been selected, and that he enters for the first time a factory department in which no time studies have been previously conducted, and in which the operations are divided between machines and work benches. His appearance is not a surprise, as the foreman has been informed in advance that the management proposes conducting such an investigation, and that full co-operation from the workmen and from himself is expected. It is a wise course for the time-study man to begin by tactfully seeking specific suggestions from the foreman as to how the work of the department may be facilitated. This usually has the twofold effect of awakening the foreman's interest, and of uncovering inefficiencies of a general character that may hitherto have been neglected, or escaped the attention of the management.

As a preliminary to the time study, the observer must consider conditions of an external character, which, in varying degree, influence the operation. If the latter is performed on a machine, he must determine whether the machine is located so as to secure efficient routing of material from and to other operations. He must quickly establish whether, all things considered, the machine is of the best type for that particular operation; whether it is running at an efficient rate of speed; and whether the tool is feeding correctly and is of proper design. If the operation is performed at a work-bench, he must decide whether the bench is suitably designed. Work-benches may be unnecessarily large, or uncomfortably small. He must then establish an efficient layout for all the benches so as to secure adequate working space, ample aisleways, and straight-line routing for materials without retrogression. He should also consider the question of illumination, and form an opinion as to whether the operations are adequately served by windows and artificial lighting media.

When these preliminary features have been provided for, the observer can proceed with the actual time study. The details of procedure at this stage have been so frequently and excellently discussed in many publications during recent years, that it seems almost a waste of time and space to again reproduce them. Brief mention will, however, be made of the more important steps, after which we may pass to certain applications of time study which possess, to some extent, the virtue of newness.

There are two recognized methods of timing the performance of an operation. The first of these is known as the *simple or overall time study*, and it consists of starting a stop-watch at the beginning of an operation, stopping it at the end of the operation, and recording the elapsed time thus obtained. This method is perfunctory in the extreme, it is in no sense a *time study*, and merits only the dubious comment that it is somewhat better than nothing at all. The second method, known as the *unit time study*, is more scientific in character and involves an analysis of the operation into its constituent elements or suboperations. These elements are noted on an observation sheet in their cyclical order of occurrence, and an actual stop-watch observation of the operation is then taken, the accurate time spent in the performance of each of the elements being recorded. A workman, thoroughly skilled, but of average speed, should be selected for observation,

[1] MANAGEMENT AND ADMINISTRATION, October 1923, p. 460.
[2] MANAGEMENT AND ADMINISTRATION, March 1923, page 306.

as the object of the study is to obtain a fair average time measurement of the operation. Subsequent computation, also, will be much facilitated by the use of a stop-watch with a dial graduated decimally into minutes, tenths, and hundredths, and the recording of time values in this way, rather than in minutes and seconds.

When the time analysis has been thus obtained, it is carefully scrutinized, and unnecessary elements discarded. The operation is then synthesized or reconstructed, and when an adequate fatigue allowance, usually in the form of a percentage, has been added, it can be regarded as a standard task with an established time equivalent.

Task-Setting and the Instruction Card

Some expedient must now be found which will inspire the workman with a constant desire to perform the newly organized task in the standard way and time. This end will, very obviously, not be accomplished by giving him a verbal instruction and leaving him to his own devices. He must be systematically trained in the details of the task, and impelled to its mastery by means of an incentive in the form of a bonus rate, so calculated that it will give him a substantial increase over his customary hourly earnings, if he faithfully and successfully works along the lines indicated.

The simplest and most satisfactory way of training him consists of assembling the details of the task very minutely on an instruction card or sheet, and giving a copy of this to the department foreman, who then assumes the responsibility for training his workmen along the prescribed lines. In executing this responsibility, he must have the full support of the planning staff, who will be prepared at all times to explain any doubtful detail, and will, in a general way, extend to him every possible form of co-operation and assistance. The time-study observer must, if necessary, prove to the foreman and workmen, the entire reasonableness of the task that he has set, even to the point of going into the shop and himself performing it.

Productive and Non-Productive Work

To facilitate the distribution of that proportion of overhead expense usually termed indirect or expense labor, it has been found advisable to range all the work of a factory into either of two classes, known respectively as "productive" or "non-productive" work.

Productive operations may be generally defined as those which are directly engaged in turning out the product. This characteristic gives rise to the term "productive" or "direct labor," used to distinguish that proportion of the labor engaged in the performance of productive or direct operations. Most machining operations other than those devoted to repairs, plant maintenance, or experimental work, and all operations in which component parts are assembled into a finished product, fall into this classification.

Non-productive work includes those operations which are not directly concerned with manufacture of the product, but which are indirectly necessary or incidental thereto. All administrative, supervisory, and clerical functions, and all work having to do with upkeep of the factory, such as plant maintenance, janitor service, and porterage, necessarily fall into this class. As inspection operations must be somehow classified, they will, in this article, be treated as non-productive in character.

While considerable progress has been made in the application of time study to the standardization of productive operations, those that lie in the non-productive class have not received the same attention. It is a matter of experience with the writer, however, that a considerable saving can be effected by extending time study and the standardization principle to many forms of non-productive work.

The Standardization of Productive Operations

In Fig. 10 is reproduced an actual "Time-Study Observation Sheet" showing in detail the time analysis of a simple operation familiar to all manufacturers of electrical conductors. This operation consists of brazing the ends of two wires during the process of stranding an electric cable, and it is selected as an illustration because of its simplicity and also on account of the frequency with which it occurs in all branches of our extensive wire industry.

This figure merits a careful scrutiny. The form as represented was drawn up only after careful consideration of all the factors, physical and psychological, that influence a time-study investigation. It will be observed that its most obvious feature is the title, "Time-Study Observation Sheet," extending in bold type across the entire top of the sheet. This title proclaims with premeditated frankness the purpose of the form, and it has been read without difficulty by the writer, when in the hands of an observer 30 ft. away. Its second outstanding characteristic is that of simplicity. Each column is headed by a simple caption explaining in a few terse words the purpose of the column, as "Description of Operation," "Type of Machine," "Total Time," "Total Time Should Have Been," etc. By silently advertising its purpose throughout many factory departments this sheet has proved a powerful factor in disarming suspicious and antagonistic workmen. It is a habit with the writer to suggest to a new observer the wisdom of occasionally laying down his observation board at some point convenient to the workmen under observation, and then leaving it for a few minutes. He will frequently find on his return, not only the workman that he was observing, but also one or two others studiously scanning the observation sheet. He can then invite and answer questions bearing on the time-study, and in this way familiarize the workmen of the department and gradually those of the entire factory, with its purpose and details.

Turning to the details of the time analysis shown in Fig. 10 we find that the operation consists of brazing ends of wire during the stranding of electric cable on a Torrington stranding machine; also that the brazes are necessitated by breaks in single wires that occur frequently during the stranding operation. We further ascertain that the brazing operation is performed by the strander operator assisted by his regular helper, the stranding machine being shut down until a satis-

factory braze has been made. The sheet informs us that 14 such brazes were observed by the time-study man, and that he analyzed the operation into the following four elements, thus recording 14 stop-watch readings on each element:

1. Cut ends of wire and light gas.
2. Braze ends of wire together.
3. Smooth brazed surface with file and emery cloth.
4. Take up slack wire.

We finally learn that the average time per braze during the observation was 3.67 min., and then when the individual elements were scrutinized and unnecessary time discarded, a standard time of 3.2 min. per braze was readily established. This, together with a listing of standard tools and brazing materials, completes the picture of a simple productive operation, the performance of which may be regarded as having passed through an effectual process of standardization.

The standardized details of the operation must now be assembled in the form of an instruction card, suitable for use by the foreman in training his workmen. Such an arrangement is reproduced in Fig. 11 which shows the detailed results of the brazing time study just described, reassembled as a standard instruction card. These cards are sent to the foreman to be maintained by him in a departmental file, while a copy of each, together with copies of corresponding observation sheets, are filed in the records of the planning office.

It might be well to emphasize the importance of making, wherever possible, what are known as *group time studies*. With many types of machines, notably those used in the textile and wire industries, output is controlled by mechanical media which vary the speed of operation for different types of product. These changes of speed may be effected by change gears installed in the machine as in the case of stranding machines, braiders, twisters, etc.; or by pulley steps on line-shafting, as in the case of most of the familiar machine shop units. The best procedure in time studying these operations is to determine standard output figures corresponding to several selected speeds, such as fast, medium, and slow. The output for intervening speeds may then be either interpolated graphically or estimated in the form of standard output tables.

Fig. 12 shows such a tabulation as applied to the braiding of cotton insulation around rubber-covered wire on Wardwell braiders. The speed of the operation, and therefore the standard hourly output, is directly controlled by change gears. The latter with corresponding output figures are tabulated in ascending order of speeds as indicated by Fig. 12.

TIME STUDY OBSERVATION SHEET

DEPT NO 300 OPERATION NO. 4840-S DATE June 23, 1915

EMPLOYEE'S NAME	STATUS	CLOCK NO	DESCRIPTION OF OPERATION	TYPE OF MACHINE	REMARKS
J. Wilson	Strander Operator	299	Brazing ends of wire during stranding of electric cable	Torrington Strander	Brazes necessitated by breaks in wire that occur frequently during the stranding operation.
H. Jones	Helper	270			

ANALYSIS OF OPERATION	Observation Number 1	2	3	4	5	6	7	Observation Number 8	9	10	11	12	13	14	AVERAGE CYCLE	AVERAGE ELEMENT
1. Cut ends of wire and light gas	0.52	0.60	0.65	0.60	0.50	0.65	0.55	0.55	0.62	0.65	0.55	0.50	0.65	0.65	0.58	0.50
2. Braze ends together	2.00	2.25	2.32	2.30	2.50	2.10	2.25	2.10	2.15	2.25	2.25	2.15	2.20	2.25	1.64	1.60
3. Smooth brazed surface with file and emery cloth	2.65	2.85	2.90	2.85	3.00	2.72	2.80	2.75	2.85	2.85	2.75	2.75	2.80	2.90	0.60	0.60
4. Take up slack wire	3.50	3.70	3.80	3.75	3.80	3.52	3.60	3.90	3.60	3.63	3.55	3.50	3.70	3.75	0.85	0.55
TOTAL															3.67	3.25

CYCLOMETER READING 1	CYCLOMETER READING 2	TOTAL OUTPUT	NO. OF MACHINES	THEOR. OUTPUT PER HOUR	TOTAL TIME	FACTOR	ALLOWANCE	ACTUAL TIME	REMARKS
					3.67 min per braze			3.25 min. per braze	Operation performed by strander operator assisted by helper.

SPEEDS FEEDS CUTS, TOOLS LUBRICANTS ETC

CHANGE GEARS A	CHANGE GEARS B	DIAM. OF PULLEYS	SPEED OF SPINDLES R.P.M.	SPEED OF LINE SHAFT R.P.M.	CUTTING SPEED	FEED	LUBRICANT	DESCRIPTION OF TOOLS	OBSERVER
								1. Gas burner. 2. Wire cutters. 3. Small file. 4. Emery cloth.	Cogshall

FIG. 10 TIME-STUDY OBSERVATION SHEET SHOWING TYPICAL UNIT TIME STUDY OF A SIMPLE PRODUCTIVE OPERATION

The Standardization of Non-Productive Operations

Earlier reference has been made to the attitude commonly assumed by management, that non-productive operations are not as vital as are those concerned with direct manufacture, and that their standardization is, for this reason, a matter of secondary importance. It has occurred to comparatively few, for instance, that the simple operations of window-cleaning, floor mopping, sweeping and dusting, which together comprise what is usually termed janitor service, may be minutely time studied, standardized, and with the application of a suitable bonus-incentive, have their productive efficiency increased to an astonishing degree.

An actual instruction card illustrating the details of an efficiently standardized window-cleaning operation is shown in Fig. 13. It will be observed that two kinds of windows, symbolized respectively as *styles A* and *B*, are represented, and that style

A windows possess four 56 x 2 in. panes, while each style B has eight 26 x 27 in. panes. These windows are cleaned on the inside only, and it might be mentioned that in most manufacturing establishments this practice will be found sufficient. In localities where a considerable amount of soft coal is burned, and the atmosphere is laden with sooty smoke, the outsides of panes will perhaps require cleaning also. Next are listed the necessary equipment and materials, and then the following elements or suboperations in their proper order of occurrence.

1. Carry pail of hot water from nearest faucet. One pail for each five windows.
2. Place step ladder in position before window.
3. Mount ladder, and place pail, rags, soap, etc., on shelf.
4. Starting at top panes, wash thoroughly, using sand to remove grease, if necessary.
5. Starting at top panes, dry thoroughly.

At the foot of the instruction card we find that the standard time for cleaning one style A window has been set at 10 min., and for a style B window at 12 min., which gives a standard output of 6 style A's or 5 style B's per hr. The rate per window is finally indicated.

Planning Dept. No. 50-P *Date*.....

INSTRUCTION CARD

OPERATION—BRAZING ENDS OF WIRE DURING STRANDING OF ELECTRIC CABLE

DESCRIPTION—Brazes necessitated by breaks in wire that occur frequently during stranding operation.

LOCATION—Dept. No. 300 (Heavy wire stranding)

EQUIPMENT AND MATERIALS

1. Gas burner.
2. Wire cutters.
3. Small file.
4. Emery cloth.

SUBOPERATIONS (in cycle)	Standard time, (min.)
1. Cut ends of wire and light gas	0.50
2. Braze ends together	1.60
3. Smooth brazed surface with file and emery cloth	0.60
4. Take up slack wire	0.55
	3.25

Standard time per braze	Rate per braze	Rate to be divided between strander gang (one operator and one helper) in proportion to their regular hourly rates.
3.25 min.	$0.08	

Signed..... *Approved*.....
Planning Dept. *Superintendent.*

FIG. 11 SHOWING THE DETAILS OF THE PRODUCTIVE OPERATION IN FIG. 10 REASSEMBLED AS INSTRUCTION CARD FOR USE IN TRAINING WORKMEN

By standardizing the window-cleaning operation in this manner a considerable saving is effected in the cost of the operation itself, while an additional economy is found in the material reduction of electric light bills. A beneficial result of equal importance, however, is the improved psychological effect on a working force of enhanced illumination.

Other forms of janitor service lend themselves readily to time analysis and standardization. Factory floors can be divided into uniform units of area, and bonus paid for the sweeping or mopping of one or more of these units within a predetermined standard time. The operation of sweeping out and dusting private offices can be similarly analyzed and profitably placed on a bonus basis of so much per office.

Bench Inspection

The objection that has always been urged to placing inspection operations on a bonus basis, is that under the stimulus of an incentive, the inspector will speed up to such an extent that the quality of the inspection will suffer, defective work being passed along with the good work. This danger, however, can be easily overcome by systematically reinspecting a definite percentage of the inspected material, and establishing a system of penalties based on the percentage of bad work found during the second inspection. Such a system is described by F. W. Taylor,[3] with reference to the inspection of bicycle balls in the works of the Symonds Rolling Machine Company in Fitchburg, Massachusetts. The operation was of a repetitive character, and was performed by girls seated at benches. By reorganizing the work somewhat, then standardizing it and placing it on a piece-work basis with a second-line or overinspection to insure that there would be no falling off in quality, the following important results were obtained:

WARDWELL BRAIDERS (New Style)

Change Gears, Speed Ratios, Turns per ft. of cottons, Lays, and Standard Outputs.

SPEED OF BRAIDER SHAFT—106 R.P.M.

CHANGE GEARS		SPEED RATIO	TURNS PER FT.		LAY (IN.)	OUTPUT FT. PER HR.	
Driver	Driven		Min.	Max.		Theo.	Actual
13	58	0.2241	65	67	0.182	128.8	118.9
13	50	0.2600	55	57	0.212	149.5	158.0
13	42	0.3095	46	48	0.252	177.9	164.2
20	62	0.3226	44	46	0.262	185.5	171.2
20	54	0.3704	38	40	0.301	212.9	196.6
20	50	0.4000	35	37	0.325	230.0	212.3
20	46	0.4348	32	34	0.354	250.0	230.7
20	42	0.4762	30	32	0.387	273.8	252.7
30	62	0.4839	29	31	0.394	278.2	256.8
20	38	0.5263	27	29	0.428	302.6	279.3
30	51	0.5556	25	27	0.452	319.4	294.8
20	34	0.5882	24	26	0.479	338.2	312.1
30	46	0.6522	21	23	0.531	375.0	346.1
30	42	0.7143	19	21	0.581	410.7	379.0
30	38	0.7895	17	19	0.642	453.9	418.9
30	34	0.8824	15	17	0.718	507.3	468.2
30	30	1.0000	13	15	0.814	575.0	530.6

FIG. 12 TABLE OF STANDARD MACHINE SPEEDS WITH CORRESPONDING OUTPUT FIGURES ESTABLISHED BY GROUP TIME STUDY

The operation consists of braiding cotton insulation around rubber-covered wire on Wardwell Braiders.

1. Thirty-five girls did the work formerly done by one hundred and twenty.
2. The girls averaged from $6.50 to $9 per week instead of $3.50 to $4.50 as formerly.
3. They worked only $8\frac{1}{2}$ hr. per day, while they had formerly worked $10\frac{1}{2}$ hr. per day.
4. An accurate comparison of the balls which were "inspected under the old day work system, with those done under piecework with overinspection, showed that in spite of the large increase in output, there were 58 per cent more defective balls

[3] See "Shop Management," by F. W. Taylor, p. 85.

left in the product as sold under day work than under piecework.

These remarkable results found a striking parallel a few years ago in the inspection department of a concern engaged in the manufacture of roller bearings. The inspection operations on rollers were repetitive in character and were, in a similar way, performed by girls seated at benches. The inspector, using contour gages, checked each roller for length and diameter after which she placed a number of these in a parallel row on a flat board and rolled them to and fro, picking out defectives as they appeared, and dropping those free from defects into openings leading to bins located beneath her bench.

A preliminary survey of this operation as originally conducted, revealed the following conditions which were regarded as inefficient:

1. The work was entirely unstandardized. No record was kept of the daily performance of individual inspectors, and no standard as to what constituted a day's work from them was in existence.
2. There was no intelligent way of checking the quality of work performed by each inspector. Rollers passing inspection were conveyed to a storeroom situated on a floor beneath the inspection floor, and lost their identity as far as the inspectors were concerned. A re-inspection of the work of nine average girls during the investigation, revealed the fact that a percentage of defective work as high as 13 per cent of the total inspected rollers, was passing to the storeroom without the knowledge of the department foreman, and with no means of tracing it back to the inspector responsible.

Roller inspection was conducted on the day work or hourly basis. Experiments conducted during the investigation demonstrated the fact that this work could be standardized and placed on a bonus basis with a considerable increase in production and a great reduction in the percentage of defective work remaining in the material passed by the inspector.

To correct these conditions the department was reorganized along the following lines. Eighty-five per cent of the girls were formed into a first line inspection, while the remaining 15 per cent were constituted as a second-line or overinspection to reinspect 15 per cent of the work of the first line. The inspectors were then paid a bonus for the rollers inspected by them in excess of predetermined output standards, and were penalized for bad work found at the overinspection bench by having a definite percentage, corresponding to a definite percentage of bad work, deducted from their earnings. The second-line inspectors remained on the hourly basis, but were given a substantial wage increase. The schedule of penalties was as follows:

PENALTIES FOR BAD WORK

Percentage of bad work found by overinspection. (Per cent inclusive of low figure.)	*Percentage to be deducted from gross earnings.*
0 to 1	None
1 to 2	2
2 to 3	4
3 to 4	6
4 to 5	9
5 to 6	12
6 to 7	15
7 to 8	20
8 to 9	25
9 to 10 and over	30

The ultimate results from this reorganization were highly successful, and entirely consistent with those obtained by Taylor in the bicycle ball instance described earlier. *The average hourly outputs of the girls on the first inspection line, underwent increases of from 50 to 100 per cent, the percentage of bad work passed by them was reduced 55 per cent, and the hourly earnings of the girls increased from 25 to 50 per cent over corresponding figures obtained on the day work basis.* In addition, the labor turnover, formerly high in this department, was materially lessened, and the entire department was brought under an adequate system of control, previously lacking. These methods were rapidly extended to other forms of bench inspection and proved equally successful in all applications.

The principle of standardization may thus be profitably applied to many types of non-productive work which have hitherto been neglected owing to an illusory idea that these operations are not readily susceptible to analysis and measurement. Every factory presents its own problem, calling for a manner of treatment constructively adapted to the exigencies of the specific case.

The benefits reaped by the small factory through a proper recognition and utilization of the standardization principle are identical with those experienced in a medium or a large organization.

(To be continued in the May issue.)

Planning Dept. No. 200-N *Date*.....

INSTRUCTION CARD

OPERATION—WASHING FACTORY WINDOWS (Styles A and B)

DESCRIPTION—Style A, panes 56 x 27 in.—4 panes per window.
Style B, panes 26 x 27 in.—8 panes per window.
Windows washed on inside only.

LOCATION—Style A—On all factory floors.
Style B—On sixth floor only.

EQUIPMENT AND MATERIALS

1. A 10-ft. step-ladder with folding shelf.
2. A pail of hot water.
3. Soft soap or "Bon Ami" cleanser.
4. A box of sand.
5. Flannel rags.

SUBOPERATIONS

1. Carry pail of hot water from nearest faucet. One pail for each five windows.
2. Place step-ladder in position before window.
3. Mount ladder, and place pail, rags, soap, etc. on shelf.
4. Starting at top panes, wash thoroughly, using sand to remove grease, if necessary.
5. Starting at top panes, dry thoroughly.

Time per window	Output per hr.	Rate per window	Male or female help
Style A—10 min.	6 windows	$0.067	
Style B—12 min.	5 windows	0.080	

Signed..... *Approved*.....
Planning Dept. *Superintendent.*

FIG. 13 INSTRUCTION CARD SHOWING THE ASSEMBLED DETAILS OF A TYPICAL NON-PRODUCTIVE OPERATION—THE CLEANING OF FACTORY WINDOWS

Profits from Better Equipment

Prompt Adoption of Improved Machinery is Business Assurance

By WILLIAM R. BASSET

Chairman of the Board, Miller, Franklin, Basset & Co.

Index Number
658.17 Production equipment
658.581 Machinery maintenance

WHEN I want to get a quick and generally accurate indication of the skill and progressiveness of a manufacturer I try to find out the average age of his productive machines.

For example, not long ago I became quite closely acquainted with the affairs of two similar and competing machine shops. One was getting the bulk of the business at a nice profit because its costs and prices were low. The other was dragging along, getting a little business, and making only a bare thimbleful of profits.

The first one depreciated its machine tools at a rate which took account of obsolescence. The less profitable concern looked upon a tool as good for its full life of 15 or 20 years. In fact the owner proudly pointed out old war horses that, as he said, "Had been giving good service for 30 years."

Although the first concern had to include in its costs a much larger amount of depreciation, its total cost was the lower because it was using only the latest and most efficient tools.

There is no greater sale advantage than a low price based upon a low production cost. The concern which is achieving lower costs leads in volume of sales and profits.

The age of the industrial equipment is a safe indicator of the ability to achieve low costs. That is, the concern which replaces its equipment so soon as better is devised is nearly always more profitable than the one that waits for its equipment to wear out before making replacements.

Better Equipment Nearly Always Profitable

The concern which replaces its equipment as soon as better equipment is devised, and which is constantly alert to substitute mechanical power for man-power, is nearly always more profitable than the conservative one that waits for machines to wear out, and that thinks men are cheaper than machines.

The value of the most modern cost cutting machinery is quite generally realized by all shop managers who can, by any stretch of the imagination, be called "progressive". Almost all of the profitable plants I know are headed by men who are very open-minded in their willingness to investigate every device or tool that promises to do a job more rapidly or more cheaply.

One that I have in mind sets aside a section of its plant for an experimental shop. Any salesman with a new device, that on the surface looks like an improvement, is given the opportunity to instal it on this testing floor. It is thereupon put into regular production, operated by one of the prospective purchaser's own workmen, who will have to operate it if it is finally adopted. This concern's costs are the lowest I have ever seen for similar work. Its plant might almost be used as an exhibit of modern labor-saving equipment.

Here are a few instances where modern equipment —both productive and so-called "non-productive"—has been installed with excellent results on costs and profits.

First there is the case of a foundry which employed —and still employs— 30 men. It is the type of foundry built some 20 to 30 years ago. It needed greater production, but in order to make a profit in competition with some of the more recently built foundries it needed lower costs still more.

As a means to this end the following changes were made:

1. Sand hoppers were installed which fed the sand *down* to the molder to relieve him from the arduous and slow labor of lifting the sand from the floor to the flask on the bench.
2. A pneumatic hoist on an overhead track was installed, which conveyed the poured molds to the shakeout pit.
3. A bucket conveyor now lifts the sand from the shakeout pit to the sand cutter overhead from where it is conveyed by a newly installed conveyor to a cooling pit.
4. An industrial track was installed, upon which dump cars run that take the sand from the cooling pit to the hoppers.
5. An overhead crane has been provided to carry a big ladle from which all pouring is done, thus doing away with hand pouring.
6. Electric lift trucks were bought for transporting the heavier flasks.
7. To allow the use of the electric trucks a smooth, strong floor was laid, as the former dirt floor was unsuitable.

The total cost of these improvements was between $33,000 and $34,000.

In order to induce the men to use this more efficient equipment to its greatest capacity a bonus was devised and put into operation. Incidentally, that is a point worthy of note. A great deal of labor-saving equipment is not so effective as it might be because workers are often opposed to it, and feel that it is installed to cut down the number of men employed. If they are given an incentive to use it they, generally, are willing to co-operate.

As to results, the same force of men in the first six

months after the new equipment was installed, produced 64 per cent more tonnage than ever before. Individuals increased their production as much as 108 per cent. Moreover, they received, due to the bonus, a higher wage. Overhead went up hardly at all, only as much as was necessary to cover the added charges due to $34,000 worth of new equipment.

The cost of the product was reduced 27 per cent, which was enough to pay for the installation within 5 months. That is so often the case, that it emphasizes the shortsighted policy of executives who continue to get along without labor-saving equipment because, as they say, "We can't afford the investment".

This installation actually saved $21,000 a year in direct wages alone, which would otherwise have been paid to get the 64 per cent increased production. That is a rather neat addition to profits.

Two Forge Shop Examples

Sometimes insignificant additions to equipment will make notable reductions in costs. Take, for instance, the battery of power hammers in a large forge shop. The operator after forging each piece had to walk several feet to a shear to cut off some material. Simple shears were purchased which were attached to the hammers so that the time spent in walking was eliminated. This inexpensive device saved 30 per cent of the direct labor—a saving which in such a large forge room added a good many thousands of dollars a year to the concern's profits.

In another forge shop were several big hammers. Only every alternate stroke of these expensive machines was utilized because the operator had to turn his back and throw each piece onto a pile some 20 ft. away. A simple conveyor was installed to the left of each hammer, on which the operator slides the forging easily. It is carried by the conveyor to an industrial track where it is dropped into a car. The former production of 10 pieces a min. has been doubled by using each hammer stroke productively. On this operation the labor and expense costs have been cut in half.

Lack of balance between the productive machines in various departments often retards production seriously. A careful study in one shop showed such a condition. Buying only 5 per cent more tools, to put everything in balance, increased production 18 per cent.

A Boiler Shop Testing Tub

Another kind of lack of balance sometimes exists where a gang of men together operate several machines. In a boiler shop the boilers were tested in three test tubs, each tub operated by one man. Time study showed that each man was idle 37.6 per cent of his time. It was found that this time could be utilized if an additional tub was installed. Four tubs are now operated by two men, instead of three by three men. The wages of one man are saved and the production is 33 1/3 per cent greater.

There have been so many developments in equipment designed to handle coarse, bulk materials that it is hard to see how managers can justify the use of hand methods. A manufacturer of concrete pipe, who used sand and gravel in large quantities, had his workmen unloading the cars with shovels. Each shovelful had to be laboriously thrown over the side of the car.

We recommended a simple type of portable swing hoist and four dump buckets. Two shovelers in the car now keep busy filling two buckets each, while the two more men on the ground operate the hoist and dump the buckets. The cost of unloading has been reduced 38 per cent.

At this same plant we found a gang of men unloading cinders with the same scoops which they used for gravel. Five shovelsful of gravel weighed 64 lb. while five shovels of cinders weighed only 32 lb. Scoops were provided for cinders having twice the capacity of those used for gravel. A gang of half the size now unloads a car of cinders in the same time that twice as many took. Enough was saved in wages on the first six cars unloaded to pay for the new scoops for the entire gang.

We once saw two men unloading bricks from a car, putting them into wheelbarrows and transporting them 40 ft. where another man stacked them. It took 212 operator minutes to unload and stack 1000 bricks. A set of roller chutes were bought with which two men get enough increased production to reduce the unloading cost by half.

There are undoubtedly some plants which can make large and spectacular savings. More often the savings will be individually small but in the aggregate will reach respectable figures. I have in mind a small concern that for a number of years had been averaging net profits of about $30,000 a year. It installed several labor-saving devices such as trucks and conveyors, more modern productive machines, a crane, and so on. No individual saving was more than $1600 a year, yet the total was $14,000. New, modern equipment increased the net profits nearly 50 per cent and they were not merely theoretical book profits but real ones that could be taken out of the business.

The Aggregate of Small Savings

It does not pay to sneer at small savings as inconsequential.

One foundry was cleaning its castings with files—and they were old files at that—for economy. A small investment in air chisels and portable grinding wheels reduced the cleaning time—and cost—two-thirds. Mistaken economy is frequently costly, as has been said often, with but little apparent effect.

The average man doing common labor will seldom ask for better equipment to use in his work, but he has no hesitancy in calling loudly for more men to help him. It is purely up to the executive to study methods and see what possibilities exist for doing things mechanically.

In a paper mill, for instance, the rag-sorters would pick up an armful of rags, carry them to a bench, and pick out the rags of a certain type. They would then throw those they rejected back into the pile and take a fresh batch. Obviously many of those rags were handled over and over. A slow-moving belt-conveyor was installed which passed before the pickers. Each now selects the type of rags he wants, and the dirt and

scrap is automatically dumped and removed. That conveyor saves $2500 a year in wages.

The packing of lampblack offered two chances to save by adding equipment. A semiautomatic machine, tended by one man, was used for filling the sacks. The attendant spent his time securing the sacks, opening them, loading, sweeping, and cleaning. He was idle just 75 per cent of his time, waiting for the sacks to fill. An additional filling machine was purchased. He tended both machines, doubled his production, and still had time to keep his part of the room clean.

These round sacks of lampblack when filled were packed in square boxes for shipping. To make them fit snugly it had been the practice to hammer them down with mallets. Of the total time required in packing, 68.6 per cent was taken up by this primitive method. A machine builder was asked to devise and build a power-operated press which could load several boxes simultaneously. The time required for hammering the sacks was 3.95 min. per sack. By power it is now 1.1 min. per sack.

Another small but worth-while saving was in a boiler-room where a man spent four hours daily wheeling coal from the bunkers to the boiler-room in a wheelbarrow. An industrial track, and side-dump coal cars now make it possible for the fireman to bring his own coal easily, in addition to his other duties. Half of the wages of even an unskilled laborer is not to be sneezed at in a small plant.

Wasted Space in Wooden Boxes

The stockroom of one plant was so congested that the owners were faced with the necessity of putting up an addition to the buildings. That, of course, would entail a permanent expense for interest, upkeep, taxes, and so on. We were asked to find a way out, if we could.

One point that struck our engineers at once was that the parts, which were small, were all stored in wooden boxes. Measurements showed that the boards were so thick that of the 26,000 cu. in. of space taken up by a box, exactly one-fifth was wood. Twenty per cent of the floor space was required by the wooden sides of the boxes. Even more space was taken up by wooden racks. An empty box required as much space as a filled one.

It took but little urging to get that concern to spend a few thousand dollars for steel boxes and shelving, which, being thin, took up much less space than did the wood. In addition the sides of the boxes sloped so that when not in use the boxes could be nested. All of the needed storage space was obtained for an expenditure about equal to the annual charge for an additional building.

It is hard to conceive of a textile mill inspecting cloth by hand, yet we recently did see one. It took 5.04 min. to inspect one roll—a new machine now does it in 1.47 min.

Many improvements can be made in the old methods of packing. Nailing machines alone make great savings.

Sometimes special packing machinery is worth while. Little peppermint candies of which millions are made each year were formerly counted, wrapped, labeled, and boxed by hand. Forty-five girls sat at tables on which were loose piles of the candy. With three-tined forks the girls would gather the candies in an almond row of proper size and then roll them in foil and glue on the label.

Machines have been installed that are fully automatic. Each of the 15 machines is tended by one girl who is there only to make adjustments and to remove any broken bits of candy that may appear. The total pay-roll is now $405 a week as against $765, and the 15 girls receive 60 per cent more wages. There is a good-sized addition to net profits.

Using Equipment to Destruction

There is one more point that bears on the economical use of machines especially of those that are apt to become obsolete in a few years. It sometimes pays to drive a machine at a speed considerably beyond the maker's recommendation, even at the cost of wearing it out much more quickly. Whether it is advisable depends largely upon the ratio of the cost of the machine to the labor and expense rate.

For instance, in one machine shop we found a battery of tools which cost $1500 each and which should not wear out in less than 15 years. That gave a depreciation of $100 a year per machine. The wage rate of the operator was 80 cents an hr., and the rate of overhead 150 per cent on the direct labor, making the hourly cost $2. The cost of labor and overhead for one machine for a year of 300 8-hr. days was $4800.

A few tests showed that these machines could be speeded up 15 per cent and still turn out perfect parts, but that so doing would involve such a strain that the machines would wear out in five years. That is, the depreciation would be $300 instead of $100. But the increased production with no extra expenditures for labor and expense would give a gain, at cost, of $720. Taking the extra depreciation into account gave an addition to profits of $520 per machine.

This is often worth while, especially, as I have suggested, if the machine is of a type that is apt to become obsolete before it wears out. The course of wisdom is, if possible, so to adjust things that it will wear out before it becomes obsolete. Knowing the cost of the machine, the rate of depreciation, the labor and expense rates, and the possible increased production, the problem is a simple one in arithmetic.

To sum up, the weight of our experience which as industrial engineers has put us in touch with the operating conditions, and which as industrial accountants informs us of the financial conditions of many plants, shows that to be prompt in adopting cost reducing machines and equipment is to assure profits.

The advantage of low operating carries over into marketing. There is no greater selling advantage than a low price for a good product. Year by year it becomes more difficult for the high cost producer to compete. Within a few years it will be universally true that he who is slow to adopt modern machines and methods will be doomed. Right now the man who is even one year ahead of his competitors in achieving lower costs, leads the procession in volume of sales and of profits.

THE EDITORS' PAGE

Classification of Management Information

THE information on any major subject, such as management, for example, is so vast as to present a most difficult problem in its classification, indexing, and filing. Yet difficult as it is, it must be solved so that the permanent information in books and the current information in magazines may be pigeonholed together for immediate use whenever needed. The man who keeps himself fully and continuously equipped for his responsibilities and duties must and will have such a plan.

The prime necessity of such a classification and subject index for management information was recognized some three years ago in the original plans for *Management Engineering*. Beginning with the first issue of that journal every article was classified and the index symbol or class number printed as a part of the title. At the same time a simple, effective, automatic method of filing clipped material was devised and presented to the readers.[1]

MANAGEMENT AND ADMINISTRATION has followed the same plan of which the arrangement of this issue is a typical sample.

As the work of classifying and indexing requires expert knowledge and experience, the services of the Engineering Societies Library were secured and have been kept. Coincident with the beginning of this work was the starting of a special classification. The Library was using the Brussels Extension of the Dewey Decimal Classification and appealed to Dr. Melvil Dewey for a class number to be expanded to cover the fast-growing literature of management. The classification number 658 was assigned. Several societies and individuals have co-operated in working out the expansion which is now printed for the first time in this issue beginning on page 449. Combined with 658 to make the classification cover all the operations of a manufacturing company are parts of the expansion of 331, 332, 621, 651, and 657, etc. In all there are some 1200 items in this comprehensive scheme.

There is also included a subject index of the same items extensively cross-indexed.

MANAGEMENT AND ADMINISTRATION is keenly gratified over the completion of this important work; congratulates its readers over the possession of such a useful classification; and extends sincere appreciation to all those who assisted in its preparation. But the fundamental task is not yet finished. What has been done for the information on Management and Administration may now well be elaborated for other branches of business literature.

The need for such a scheme is amply proved by the scores of letters received during the past three years by the Engineering Societies Library and the magazine, asking when and where the full classification could be secured. Many have written that they would install the system for their own files so soon as it was available.

To satisfy just such needs the classification has been expanded to cover information broadly—it is more extensive than would be required for a collection of books in a library—as it is expected that magazine clippings, reports, documents, pamphlets, and the like will be brought freely into the working executives' files.

The value of a file developed around this classification cannot be estimated. It is worth the sum of all the savings and profits which come from the application of the information which it yields when that information is wanted. A single case may pay for the establishment and upkeep of the file for a score of years.

The permanency of the system is assured. The Dewey Decimal Classification is extensively used in libraries both in this country and abroad. The 658 table here presented will become a part of the Twelfth Edition of the classification when that volume is published. Furthermore, the greatest classified collection of management literature in the United States, that of the Engineering Societies Library, is indexed in accordance therewith. No one need hesitate to adopt it for fear it may shortly be superseded. Any changes in the future will merely be additions and more detailed extensions without modifying what is now presented.

The publication of this scheme puts another working tool or instrument into the hands of the busy executive. With it he can gather together in orderly fashion all the useful information on the subjects which appertain to his present or future work. At a moment's notice when a problem arises his file will give forth all that is worth while to aid in its solution. The day is just before us when every man having major business responsibilities to discharge will possess and constantly use such a file. The means are now available to establish it on a permanent basis.

[1] See MANAGEMENT AND ADMINISTRATION for July 1923, p. 79.

The Management Buys

MANAGEMENT AND ADMINISTRATION holds positively to the belief that the management of industrial concerns exercises the buying responsibility on major items of equipment. This situation is but a part of the progressive change taking place in manufacturing establishments in the relationships of shop men and executives. Obviously this change is to the advantage of cross-sectional magazines.

The American Machinist says in an editorial in its issue of February 28:

> The increasing size of manufacturing plants, as exemplified by the large automobile shops, is bringing changes in the relationship of the shop and the executive ends of the business. We formerly thought of the production manager as being connected entirely with the machine department and interested solely in cost of machining the various parts of a product. Now, however, the term production manager is coming to mean the man responsible for the total output of

the plant, machining costs being but a very small item in many cases.

The new production manager has in a way taken over part of the work of the old general manager or works manager. In a few instances he also *acts as purchasing agent*[1] and so keeps tabs on the cost of material and equipment as well as of labor. But he is really a production manager in the fullest sense and the increasing business handled by large plants still leaves plenty of work for the general and works managers. It is a broader and better job than ever.

Even a stronger statement about the situation in metal-working shops is in the February issue of the *A. B. P. News*:

> That the machinist is a negligible factor and that *over 90 per cent of the buying power for machine tools in industrial plants*[2] *is exerted by executives* above the rank of foreman is the essence of a report compiled by an A. B. P. member from facts disclosed by returns from a questionnaire recently completed.

When highly specialized manufacturing equipment, such as machine tools, is predominatingly bought by executives, how much more must this be true of general industrial equipment. The situation thus shown offers the opportunity for a profitable development in sales appeals, wherein successful operation and results will be emphasized and features of design and construction subordinated.

The Problems of Production

LABOR costs are higher than they have ever been before. It is unlikely that they will be lowered materially. There may and probably will be adjustments. Some classes of labor are paid higher than the work will justify, but it is not probable that labor as a whole will, in this country, be paid less in the future in real wage values than it is paid today. The standard of living has been set and there is no reason to suppose that labor will lower that standard.

Can our civilization produce enough for our workmen to continue to live as well as they do? As to this Henry Ford says:

> The best wages that up to date have ever been paid are not nearly as high as they ought to be. Business is not sufficiently well organized and its objectives are not yet sufficiently clear to make it possible to pay more than a fraction of the wages that ought to be paid.

This may be overdrawn, but it is not probable that the cost of labor can be greatly reduced. The question is, then, if the cost of labor cannot be reduced, can prices be raised? Can the consumer by salesmanship and advertising and the stress of circumstance be induced to pay more for what he buys than he now pays? No one thinks this possible. On the contrary, prices to consumers must be lowered and the manufacturers who do not realize this are the ones who are going to be crowded out of business by new, keener, and more able competition.

Can labor itself be made more productive? Those who have studied this question most carefully say that there are great possibilities of increased production for those who really know how to manage men.

American production is shockingly wasteful in every direction, but probably the greatest loss is in the failure to develop zeal for production among those who work. Employers, themselves, as a class, are responsible for this. If in piece work a few displayed unusual ability the record they made was used to cut rates for the others. If any new process increased profits the men had no share in it. If a new machine saved labor no consideration was shown for those displaced. Until the men organized in clumsy uneconomic unions and by weight of mass gained some consideration, they were treated as a part of the machinery of production, used with even less consideration, and scrapped as ruthlessly when of no further use.

The next factor that can be used to increase production is labor-saving machinery. It is here that the most striking results can be secured. We use labor-saving equipment now, more perhaps than in any other nation of the world. But because our labor costs are higher than in any other nation we have got to increase this use, and do yet more by machinery than we ever have done. As to this a recent writer says:

> America, with wages from two to nine times as high as the rest of the world, has had to exert her inventive genius as has no other country. Out of this necessity—coupled with an ingenuity inherited from generations of pioneers who had to devise almost everything they used from the raw materials of the wilderness—has developed machinery whose ingenuity is little short of marvelous. When the flexibility of the human hand can be so counterfeited in steel and other lifeless mediums as has been done in the shoe machines, in machines that will not only box and weigh damp pulverized foods but will line the boxes with waxed paper and seal them, and in machines that will cut and wrap sticky caramels in thinnest tissue, the duplication of almost all hand labor is simply a matter of time and profitableness.

Present happenings confirm this view. A New England textile mill has recently completed an automatic installation in which one operator tends 30 looms as against 8 looms under the replaced system. A new mechanical plastering mechanism operated by one man is said to spread 773 sq. yds. of plaster a day as against 80 sq. yds. a day by hand. When savings such as these can be effected, the cost of labor does not seem so high. An inspection of the patent office reports will show that the American ingenuity has not lost its cunning and that what has been done is but promise of what shall yet be done.

An important phase of the subject is the proper maintenance and replacement of equipment. The manufacturer should be as quick to discard as to adopt. Absolutely cold business logic should prevail. If an expensive machine is installed today and tomorrow is obsolete because a better machine has been brought out, the new machine, already old, should be scrapped as soon as the better machine can be put in place. The temptation to save cash outlay but increase production cost by the retention of poor or obsolete equipment is great. It is, though, a ruinous indulgence.

[1] The italics are ours.
[2] *Ibid.*

THE READERS' PAGE

Securing Additional Capital

For some months past an interesting discussion of the methods of raising capital for a small industrial enterprise has been appearing on the Reader's Page of MANAGEMENT AND ADMINISTRATION. The following letters continue this discussion:

Editors of MANAGEMENT AND ADMINISTRATION:

Your financing problem of the December issue and the various replies suggesting ways and means of solving it have been read with interest. Unless it is an exceptional case, the solution can be expressed in a few words.

I should say on general principles and an observation of over 30 years, that if some good old, sound, common-sense methods were applied to the management of the factory and business, there would be no reason for obtaining additional capital. Ninety-nine out of one hundred similar problems can be solved this way and the annual cost would not exceed the interest on the borrowed money.

Of course, this may be the one-hundredth problem, but there is every reasonable doubt that if it is as stated and not a hypothetical case, the above would be the most economical and permanent solution, as it is quite probable that too much capital has been used in development work, plant expenditures, and salaries, in proportion to cash available.

FREDERICK A. WALDRON

Editors of MANAGEMENT AND ADMINISTRATION:

Realizing the imperative need of facilities for the small enterprise in obtaining additional finance, I have read with a great deal of interest the several letters reproduced on The Readers' Page for February.

I have had some experience in this direction, for during the past year I have endeavored to interest brokers and investors in an issue of securities.

Permit me to state briefly my conclusions as to the types of brokerage houses now engaged in this class of work. I believe they can be classified into three groups; first, those brokers who participate in syndicate issues, or, being too small for participation, "broker" those issues out on a very nominal commission; second, stock salesmen who extort a prohibitive commission for undertaking the work and very frequently will not agree to underwrite a given amount.

This second plan of refinancing almost certainly will bring disaster for several reasons, chief of which is the lack of integrity and honesty on the salesman's part in the conduct of his campaign. Such a campaign brings into the company many new stockholders, but these, because of the misrepresentation, exaggeration, etc., quickly become dissatisfied with their investment and cause much trouble and unwarranted and detrimental publicity.

The third class endeavor to dispose of the securities purely by mail, and are not infrequently more interested in the compensation they receive for the preparation of the sales literature than in any resulting sales of stock. They are not to be depended upon and are open to the same objection as the second class.

One of your correspondents in the February issue makes inquiry as to the possibility of the inquirer or a group of stockholders putting their stock up with a banker as collateral for their needs. May I inquire of what value stock in the same enterprise would be to a loan of this character?

Another correspondent in the same issue has suggested a plan that to all appearances should afford a solution to this problem. However, there are some pitfalls that would have to be closely watched and difficulties to overcome in the functioning of an organization such as he suggests.

From personal association, I know the pressure that is sometimes brought to bear by companies that have been financed in this manner. They perhaps are in temporary financial difficulties, and, putting their need for more money up to the board of directors of the company which first financed them, it is difficult for this board to say "no" to the request, realizing that a refusal might jeopardize the standing of both the corporations.

This correspondent assumes, as I understand him, that all the companies financed would immediately begin paying dividends in order that the corporation doing the financing might in turn meet its interest obligations on the bonds issued, or pay dividends should stock be chosen as the medium of obtaining capital for the undertaking.

Assume that some portion of the companies financed did not do so, how would the demands of the stockholders or bondholders of the "financing" company be met? Unfortunately, the average small investor has been misled in the past into the belief that dividends come to him as regularly and with the same freedom from interruption as interest on savings accounts and other like investments.

I believe Mr. Hanford's proposition, properly safeguarded and officered by experienced people together with a sufficient clientele to whom the corporation could dispose of its paper, comes as near solving the small manufacturing company's financial problems as any I have come in contact with or learned of personally, and I wish that it were possible to have it considered by gentlemen of financial means capable of undertaking this work.

I believe it would be quite remunerative to them and certainly it would give assistance to many worthy enterprises having very bright futures, good products, and efficient management, and lacking only adequate financing to assure success.

L. W. BENJAMIN.

More Industrial Executives

A LETTER published on the Reader's Page of the January number of MANAGEMENT AND ADMINISTRATION recounted the trying experiences in seeking employment of Mr. Bell, an undergraduate with two years spent on industrial subjects. Mr. Bell found that those with practical experience and particularly those already in the line of promotion were given preference, that his college training was accorded scant respect. He asks why this should be so. Two letters have been received in response. The first from Mr. Fish tells him why.

Editors of MANAGEMENT AND ADMINISTRATION:

The letter from "Harry E. Bell" in your February number is so much like an interview which I had with a young man whose name was not Bell, that I wonder if that name is not a nom-de-plume.

This young man and I got on very nicely in our agreement that more and better industrial executives were needed, and that it was up to the colleges to help produce them. The parting of our ways came when I suggested his stepping on a rung of the ladder which he said should not be there for him. To put it another way, he thought that his time in school entitled him to step from a platform, as it were, to a rung some little way up the ladder.

What I told this young man may be of interest to many other young men who are about to venture into same stage of industrial engineering. In the first place I tried to define to him the things which a man might do for a living and be entitled to call himself an industrial engineer. All of these involved a first-hand knowledge of production, and they all involved some salesmanship, neither of which had been stressed in his college work. I told this man that while he was accumulating the money to return to college was exactly the time to accumulate knowledge of production and acquire an acquaintance with workmen as they are, by getting a real hard working manual job in some shop and working and living exactly like the rest of the gang.

That is where we split. He had not the physique to do it. He wanted to make connection with some firm of engineers and go around the country settling labor troubles. I told him that most labor troubles were settled, if settled at all, by men who knew how it feels to make a day's pay by physical effort.

It is probably just as impossible to turn an "operating" industrial engineer out of a college as it is to turn out any other kind of finished product. Every industrial engineer that I have met is selling his services day by day. He may be on a salary, but his salary has a habit of stopping when his sales effort stops.

What he is selling in one form or another comes down to increased production per unit of effort. He may be selling a wage system, an accounting system, an employment method, a safety method, a routing of work, a method of doing work, but whatever it is he is helpless without a complete knowledge of production methods plus his ability to sell continuously.

So may I advise Mr. Bell if that is his name—and some hundreds of others that have the same plaint, that they must not expect their college education to entitle them to a bit of advantage in getting a job. They must win on their own merits or not at all. Once on the job, however, they will find that they can apply what they have learned in college to make somewhat more rapid progress in their chosen field. And that is their reward.

E. H. FISH

The second letter does not tell Mr. Bell why, but it does point out with striking force the comparatively favorable position occupied by him. The letter is an interesting statement of a difficult position.

Editors of MANAGEMENT AND ADMINISTRATION:

It was interesting to note the letter entitled "Producing More Industrial Executives" largely because the case was parallel with mine. The correspondent had studied economic problems in college for two years; had sought a position where his knowledge would be appreciated; had contended that the industrial world must give the college man a fair chance. He not only was hit hard on entering the economic struggle but was baffled by the inconsistencies of leaders in industry. He accepted the economic conditions as natural but inveighed against the illogical actions of industrial executives.

I wish to inform this young man that he need not be discouraged for there are hundreds better qualified than he and more deserving who are having the doors of industry slammed in their faces. He went to college two years, whereas I have been nearly four; he can rise to president of nearly any concern, whereas in my attempt to rise I would be held back by an iron and prejudiced hand; he can seek positions and the interviewer will state the case exactly, whereas if I seek positions the interviewer generally speaks the untruth or is embarrassed at telling me the situation; his industrial opportunities are broad and plentiful, whereas mine are narrow and nearly negligible; he is a "white man" whereas I am a "colored man".

After one has sacrificed and studied for nearly four years in a higher institution of learning and then sees an unlettered alien step in the industrial door while he remains outside, he has indeed ground for discouragement. When one sees his classmates, many of whom are mediocre in intelligence, rising high in the scale of industry while he is crushed at the bottom, he has again ground for discouragement.

I wish to inform this young man and your readers, though, that *I still have courage*. I still continue my studies for "Brains Rule Commerce". As steel sharpeneth steel so does every slam sharpen my determination to go forward. I may be down today, at the mercy of industrialists; but mark ye the day is not far distant when the ones who refused to hire me might be asking me for favors.

Let me urge the young man to brace up and not take his experience too seriously, for it is light.

Yours truly,

"DETERMINATION"

Material Handling Challenge

SOME months ago the Materials Handling Division of the American Society of Mechanical Engineers issued a circular containing a formula for figuring the savings effected by improved material handling machinery. This in connection with comment in MANAGEMENT AND ADMINISTRATION brought out the following interesting letter from Mr. Jordan.

Editors of MANAGEMENT AND ADMINISTRATION:

The article by Mr. James A. Shepard in the December issue of MANAGEMENT AND ADMINISTRATION, and particularly the editorial in that number, "Material Handling Challenge," has inspired the present letter which is in fact the substance of a communication sent by me December last to Mr. Harold V. Coes, Chairman of the Materials Handling Division of the American Society of Mechanical Engineers.

I fear very much that the bulletin by the Committee was gotten up in such a way that much more explanation and enlightenment is necessary to maintain the ground taken, or else there is something wrong.

I will not attempt to discuss everything which appeals to me as needing discussion, but I cannot see the reasoning for figuring into this formula overhead on indirect labor, a procedure which, as far as my knowledge of cost work is concerned, is almost entirely out of order. On this point I believe the formula will encounter a great deal of opposition, and rightfully so, and I believe that it would be necessary to put up pretty good arguments to get this method of figuring across.

Under credit items on the second page is given Item U, Yearly Savings or Earnings Through Increased Production, and on the top of page 3 is shown Increased Earnings Due to Increased Production valued at $650 per year. If this were applied to a productive machine, there would be some basis in the writer's mind for this reasoning; but for the life of me I cannot conceive of any department in a manufacturing plant that would cripple productions through lack of promptness in moving materials. If this promptness did not occur it would be a matter of rotten management. Of course, this service would cost a great deal more when done by old-fashioned methods than by the new; but as for its increasing the production of the machines I believe the claim of savings is entirely fallacious. In other words, saving in service labor is first claimed and then the circular turns around and goes on the assumption that this service labor was entirely inadequate and that the production of the machines is increased. I do not believe such a situation ever existed. If it did, it was entirely the fault of not providing enough of the extraneous labor rather than through the methods used.

If the circular had set up a formula for material handling equipment alone, and another formula for figuring what an actual producing machine like a new milling machine or something of that sort would require, it would have been much better. Of course, there are a few cases where materials handling equipment will save the direct labor on the machine; but the application of the formula shown on the second page of the pamphlet, namely, that of an electrical storage battery industrial truck, is so far away from direct labor on any machines that the assumption of increased production valued at $650 a year is, to the writer's mind, absolutely unjustified.

Mr. Shepard in his articles assumes one of only a very few cases which can be brought out, and in that way he covers himself. An electrical hoist actually cutting down the set-up time of a machine will naturally save some direct labor. This, however, brings up the class of material handling equipment which has almost become a part of the machine itself in good shop practice, and is really not in the class of material handling, although, of course, a jib-crane is for the purpose of handling material. But it seems inconceivable that a 16-ft. boring mill would fail to have its most necessary adjunct to put the material on the bed of the machine.

What we naturally think of when material handling equipment is mentioned are such things as roller- and belt-conveyors; industrial trucks; industrial tracks, lift platforms; telpherage systems; magnets; locomotive cranes; outside crane runways; chutes; pneumatic systems, and many other things of like nature.

After all, is it not true that all of these things come right back for their full understanding to the ever-present problem of terminology?

J. P. JORDAN

Freight Rates Versus Economies

Editors of MANAGEMENT AND ADMINISTRATION:

The most important job of constructive accounting in the country today is the development of a rational scientific system of freight rates. The old railroad slogan of "All that the traffic will bear," has been succeeded by the more euphemistic, "The rate that will move the freight". There is no evidence to show that a proper correlation of freight rates from the standpoint of national efficiency has ever been attempted.

If some rates have been fixed at less than cost to kill water competition, freight may be moving by rail which in the interest of national efficiency had better be moved by water. If another rate has been fixed at less than cost because of some local situation in the early days of railroading it may be that as a nation we are using up fuel, labor, freight cars, and engines to move some article 2000 miles when a rate based on cost would indicate clearly that it would be cheaper for the nation to produce the article in question nearer the point of consumption.

Terminal costs are another factor which have never had adequate consideration in the fixing of freight rates. It has been stated that it costs twenty times as much to get a ton of freight into New York City as to haul it from Philadelphia to New York. If the cost of moving freight into and out of our great terminals is not charged against that freight, but buttered over the entire freight business of the country, we shall have to find additional huge sums to enlarge these terminals

in New York and other large cities. If, on the other hand, the freight rate can be based on costs, making it a total of the hauling cost plus the terminal costs of origin and destination, we may find that many articles now produced in congested centers can be provided at less total cost to the nation in smaller cities and towns.

If freight rates can be based on costs in the same way that the prices of a well-managed factory making a diversity of products are based on costs the ordinary laws of economics will see to it that we secure our supply of consumption articles from that source which is most economical, all things considered. So long as arbitrary and illogical freight rates are in force maintained by law and immune from the effects of competition we shall waste millions of dollars a year in the useless hauling of freight and in the acquisition of more and more expensive terminals.

The only hope of rectifying the situation outlined above is for some organization to interest itself in the problem. Is not this a proper and worth-while subject for the National Association of Cost Accountants to consider?

CHARLES H. PORTER

Just As Good

A FRIEND occupying a prominent position in the advertising world, goaded to desperation by clients, wishing to "buck" well-established products with articles "just as good," sends in the following:

A manufacturer's private office: Enter an advertising agent, escorted by the advertising manager. Introductions: "Our President, Mr. Blank; our Sales Manager, Mr. Blank." Seats for four.

"We have asked you to call, Mr. Agent," says the president, "to discuss the marketing of our new soap flakes.

"We have received reports from our salesmen," he continues, "that Lux has developed an enormous volume of business. We have decided to get into the field."

"Very interesting," murmurs the agent.

"We have the product," goes on the president. "As fine a soap flake as can be made. Mr. Blank, our sales manager, assures me that with our organization, our reputation and standing with the trade, he can put it on the dealers' shelves without difficulty. It will then be up to you to put it over with the public, and we want to know how you think that should be done—through newspapers, magazines, posters?—and what it will cost."

"Splendid," says the agent, picking up the attractive package. "You have already chosen a name. I see. Very good, very good indeed! Short, easily pronounced, easily remembered."

"Yes," says the sales manager, "the trade all agree that the shortness of the name 'Lux' has been an important element in its success."

"And your product," asks the agent, "how does it differ from Lux?"

"A little better," says the president. "We are very careful about the quality of our tallow."

"Hm!" says the agent. "Product essentially the same, then?"

"Well, yes," agrees the president.

"And the price?" asks the agent. "You perhaps have some advantage in manufacturing or buying that will enable you to sell it cheaper?"

"Oh, no!" says the president. "We will meet the market on price."

"The quantity, then—you will give a larger package for the money?" hopefully pursues the agent.

"Oh, no!" answers the sales manager. "The trade all agree this Lux size is the popular seller."

"You are going to make it easier, more convenient, then, for the women to get this product of yours?" inquires the agent (not so hopefully). "You have figured out some way to do that?"

"No—the regular trade will handle it." The president is plainly puzzled. "What are you driving at, anyway?"

"You want a straight answer?" asks the agent, a bit hesitant.

"Certainly," snaps the president, impatiently.

"Then here it is, Mr. President. Here you have a product just as good as Lux, but no better. You propose to give the same identical thing, in the same quantity, at the same price, with the same convenience of purchase and use. In God's name, what reason is there why you *should* get any of this business?"

"But I've told you that," replies the president, warmly. "It's a big and profitable market. We're equipped to make this product and distribute it. The right kind of selling and advertising ought to put it over and get our share of the business."

"Yes," said the agent. "I understand why *you* want the business. But my question is different: Why should the American women give it to you? What service will be rendered *them* by your entrance into this market? What message of self-interest have you for the user of Lux that will make her remember you when she telephones the grocer?

"Oh, yes, Mr. Sales Manager here can put these goods of yours on the dealer's shelf. And I can advertise them with all the skill and technical brilliance in the world. And we can get some of that Lux business, too. But not at a profit. Why? Because after all is done, so far as the Lux user is concerned, your advertising will only say—'*Yes!* We have no bananas today.'

"If there is some market that Lux hasn't covered, or some section of the population to whom their message hasn't percolated, all right. If you are willing to go in there and carry a message of service to *those* people and develop your *own* market, there may be something in it.

"Or, if there is some new use for this type of product that you will do women the service of telling them about, all right again.

"But unless we can find a reason from the woman's viewpoint why you should enter the soap flake business, I beg you will excuse me."

Yes, this ought to be said oftener than it is, to the manufacturer in any field who has been led to believe that, with advertising, he can beat Willie Hoppe without playing billiards.

NEWS OF EQUIPMENT
FOR THE MANAGEMENT

This department is conducted to give the essential facts in regard to items of industrial equipment which have recently been placed on the market, and which may be used in the operation of manufacturing concerns. As the sources of the items are reputable manufacturers, MANAGEMENT AND ADMINISTRATION accepts this information as reliable.

—THE EDITORS.

A Universal Meter for Electric Power

Index Number 621.3175 Electric meters

THERE has been more or less dissatisfaction with the methods used in metering large quantities of electric power. This has been caused by the fact that the watthour meter, although quite reliable and satisfactory for residence service, does not provide enough information concerning the conditions surrounding the transfer of large quantities of power. Purchasers of power for mills, factories, and various industrial applications are interested in the complex relations between voltage, current, power factor, etc., but this information cannot be obtained from the watthour meter.

A universal meter for electric power, pictured in Fig. 1, has been developed by Westinghouse Electric and Manufacturing Company for use on large power circuits. It gives direct reading of indicated power factor; total kw. hr.; total kv-a. hr.; kw. and kv-a. demand for any predetermined time interval; and the power factor for any time interval, particularly at the time of maximum demand.

One of the most important uses of this new meter from the standpoint of large industrial users of power is in connection with the determination and correction of power factor.

Power factor is the ratio of power current to total current flowing in a circuit. When the power factor is low large amounts of energy are expended in heat losses in generators, exciters, transformers, distribution lines, and all other current carrying parts. There are several methods which can be used to improve the power factor but heretofore it has been impossible to determine the true condition without considerable difficulty. With the newly perfected kv-a meter the load and power factor conditions over any period of time can be read directly and when corrective measures are introduced the resulting improvements can be recorded exactly.

The foundation of the meter is a small mechanism which gives a vector addition, under all conditions of power factor and load, of the quantities which make up kv-a. The recognized method of measuring kv-a. in a polyphase circuit is by a vector addition of the power and the wattless components of the circuits. In the new meter this is accomplished by an ingenious mechanism, connecting the two measuring elements, which furnishes direct readings of indicated power factor.

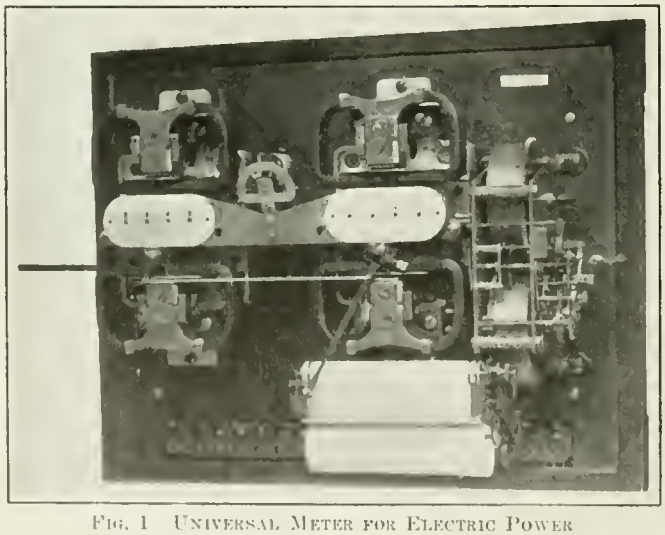

FIG. 1 UNIVERSAL METER FOR ELECTRIC POWER

A Combined Megohmeter and Voltmeter

Index Number 621.3173 Voltmeters

A COMBINED Megohmeter and Voltmeter has been developed by Herman H. Sticht and Company for use where relative valves, quickly obtainable, are of more importance than accurate insulation measurements. It is recommended particularly for maintenance work on telegraph, telephone, and signal systems. Since in size it is 3⅝ x 5¼ x 6¾ in. and weighs 4¾ lb. it will not take up much room in a tool kit and will be convenient for use by inspectors.

FIG. 1 COMBINED MEGOHMETER AND VOLTMETER

It gives direct readings for megohmic valves from 0 to 20, and from 0 to 240 volts. Operating instructions are mounted on the cover of the instrument where they are visible to the operator when taking measurements.

The instrument contains a hand-operated magneto generator which furnishes potential for insulation measurements.

Floor Vibration Insulation

Index Number 621.715 Foundations for machinery

A SYSTEM of insulating or isolating machinery from the floors of buildings, so that it will not transmit vibrations and noise, has recently been introduced into this country from abroad, where it has given acceptable service in about 80,000 installations.

It consists of small cork blocks 1 9/16 in. thick held rigidly in wrought iron frames which are made up to form sections of any desired dimensions. See Fig. 1. The frames are cross-braced in both directions,

FIG. 1 SECTION OF INSULATING FLOORING

but the resiliency of the natural cork practically closes all joints and affords an almost continuous surface. The cork is impregnated with a preservative.

The cork blocks are not granular, but are made from the original solid cork oak bark, thereby retaining all of their original resiliency and being free from the disintegration which results to granular cork under compression, heat, oil, acid, or dampness. The amount of compression of the blocks varies with the load, which is usually distributed by means of a wooden or cement base, to which the machine is bolted. The bolts, however, do not pass through the cork, and the latter forms a medium completely isolating the machine from the floor. See Fig. 2.

The resiliency of the material is proved by its recovery of thickness when compression is released. The original dimension is regained, except for approximately from 5 to 12 per cent, 5 min. after the loads are released, and under loads ranging from 10,000 to 30,000 lb. per sq. ft.

Installations are made for all classes of individual machines or power plant apparatus, for groups, or covering entire floors, where machinery is set closely. In every case the cork isolates the apparatus from the floor, insuring an absence of vibration and most of the noise. Diesel engines of 6,000 hp., gas engines of 12,000 hp., and steam turbines of 50,000 kw. have been mounted on this type of material.

This insulation is manufactured by the Korfund Company.

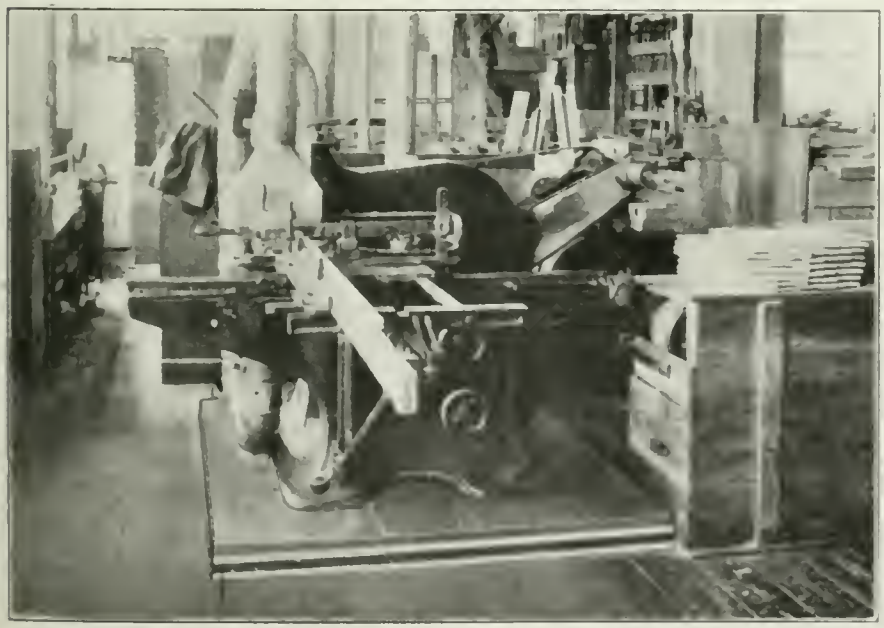

FIG. 2 USE OF INSULATION TO REDUCE NOISE AND VIBRATION FROM SAW

New Adding Machine

Index Number 651.264 Adding Machines

THE adding machine illustrated herewith has been developed for the use of engineers, draughtsmen, cost clerks, shipping clerks, and others who have to add lineal measurements and common fractions.

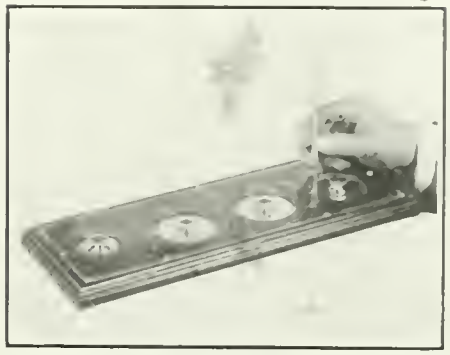

FIG. 1 "QUIXSUM" ADDING MACHINE

It consists of four dials marked respectively, Hundreds, Feet, Inches, Fractions.

The instructions for operating are: Place the point of stylus in the hole opposite the number to be added. Turn to right until the stylus strikes the stop at the top. Repeat this operation with each item of hundreds of feet, feet, inches or fractions, using the proper dial in each case. The totals will show at the left of each dial and are always in view. Read the dials across from left to right to secure the total.

The machine weighs three pounds, therefore is portable and can be operated with one hand on the draughting board or desk. Its dimensions are $15 \times 5\frac{3}{4} \times 1\frac{1}{4}$ in.

It is manufactured by the Precision Adding Machine Company under the trade name "QuiXsuM".

Man-Cooling Fan

Index Number 621.63 Mechanical fans

IT is well known that the evaporation of perspiration from the human body cools it and keeps it at a comfortable temperature. A moving column of air even though it may be quite warm feels cool as it strikes the body; a windy day seems cooler than a still day. This fact is taken advantage of in the design of "Man-Coolers," a power-driven fan made

by B. F. Perkins & Son, Inc. The machine consists of a pedestal supporting a motor driving a fan wheel. The blades of the fan are electrically welded to forged steel arms, and the arms are threaded, screwed into the hub, and locked with a set-screw.

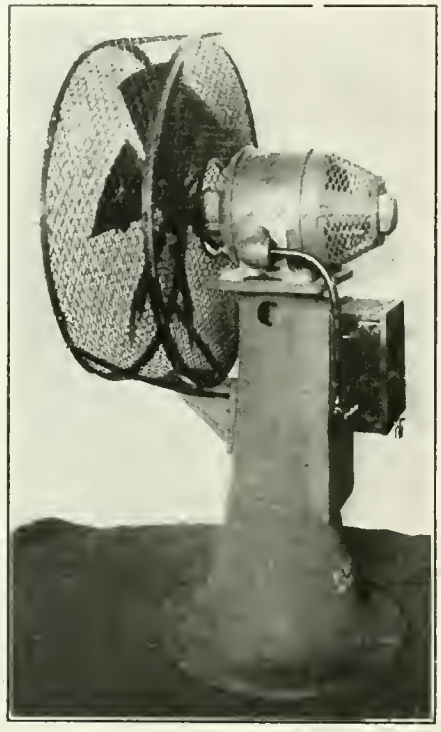

FIG. 1 MAN-COOLING FAN

The motor can be of any standard conforming to those regularly installed in the mill or factory where the fan is to be used. The complete fan is portable, that is, it can be picked up by a crane and set anywhere needed, or it can be mounted on a truck for convenient transportation.

Interchangeable Filing Equipment

Index Number 651.2 Filing cabinets

A SYSTEM of steel filing units which can be assembled into any one of a large variety of combinations has recently been put on the market. Its special features are interchangeability at any time, a method of interlocking which makes each combination a rigid unit when assembled, economy of investment, and ability to add sections whenever necessary, and to change the arrangement in doing so, if desirable.

Single-drawer units are made for

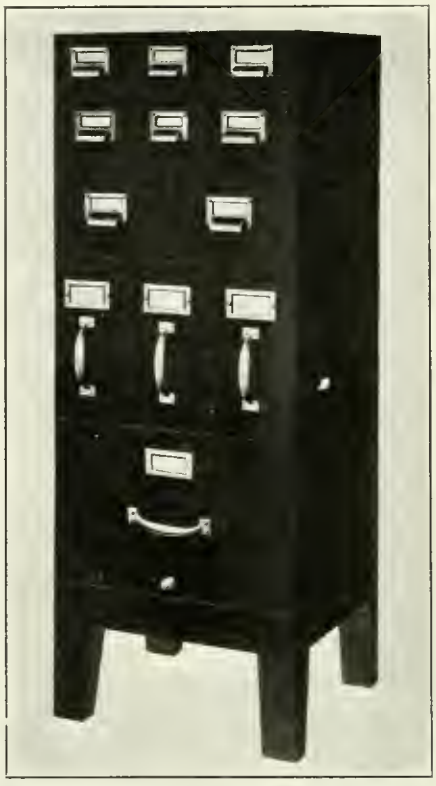

FIG. 1 INTERCHANGEABLE FILING EQUIPMENT

cards of 3 x 5, 4 x 6, and 5 x 8 in. sizes (height x width), and for documents, letters, and legal papers. Units of any of these may be combined with any others either vertically or horizontally, in multiples to form an interlocking cabinet. They may be either mounted on legs, as in Fig. 1, or rest on the floor.

As the need for more filing space develops, new units may be added. The element of flexibility makes the system readily adaptable to either general office filing of any nature, or to the specific requirements of accounting, production, sales, employment, and all other records.

The Pressteel Engineering Corporation makes this equipment.

New Line of Air Motor Hoists

Index Number 621.546 Air motor hoists

A DESCRIPTION appeared recently in MANAGEMENT AND ADMINISTRATION[1] of a 500-lb. air motor hoist put on the market by the Ingersoll-Rand Company. This new line has now been extended to include five sizes for capacities from 500 lb. to 10,000 lb. The four larger sizes are similar in design to the smallest of the line and have been developed to provide the type of hoist for heavier work.

The outstanding characteristics of the new hoists are: Compactness of design to permit use in low head room; relatively light weight; automatic braking to hold the load under all circumstances even if the air supply be disconnected or fail; and a graduated throttle to permit a close regulation of both lifting and lowering speeds. Motor and gears are

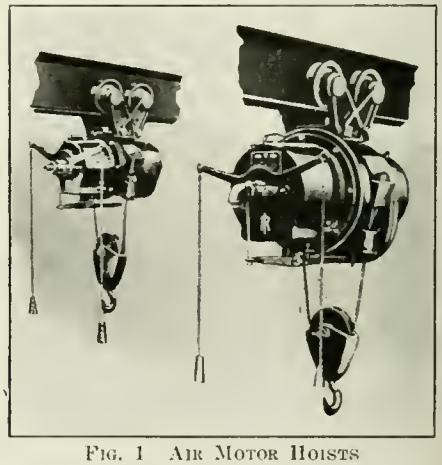

FIG. 1 AIR MOTOR HOISTS

encased and run in lubricants. Ball bearings and bronze bushings are utilized to add to the efficiency and life of the hoist.

The general dimensions of the five sizes are as follows:

SIZE	A	B	C	D	E
Capacity (lb.)	500	1000	2000	4000	10,000
Feet lift per min. (80 lb. Air Pres.)	50	25	25	17	10
Max. lift feet	15	15	15	15	15
Size and length Wire Rope	$\frac{1}{4}$ in. x 35 ft.	$\frac{1}{4}$ in. x 35 ft.	$\frac{5}{16}$ in. x 36 ft.	$\frac{3}{8}$ in. x 36 ft.	$\frac{9}{16}$ in. x 40 ft.
Net weight (equipped with top hook) lb.	150	150	315	425	760

These hoists operate on air pressures from 60 lbs. to 100 lbs.

[1] November 1923, page 639.

Information Classification for the Management Adapted from the Dewey Decimal System

Management Data Summary—Number 25

IN the classification presented below tables for 331, 651 and 658 are recent expansions of those sections of the Decimal Classification and are (with some extracts from earlier material) printed in advance of Edition 12 by permission from Decimal Classification and Relative Index, Forest Press, Lake Placid Club, N. Y., by which they will also be published in fuller form as a separate. In 1919, tables for 651 and 658 were printed as "proof under revision" and widely distributed for criticism. A revision was issued in March 1921, and during the following year an active interest in developing 658 was taken by Harrison W. Craver, Director, and Margaret Mann, chief cataloguer, of the Engineering Societies Library in New York, and by the Research Committee of the Detroit Chapter of the Society of Industrial Engineers, consisting of W. G. Sheehan, Chairman, Douglas E. Briggs, Christine H. Haller, D. Ashley Hooker, James E. Morrison, W. W. Nichols, and Carl H. Sechoffer. This resulted in the preparation by Doreas Fellows, editor of the Decimal Classification, of an extensive expansion, which in 1922 was put in type for inclusion in Edition 11 of Decimal Classification, but was withdrawn to allow for co-operation on the part of the Joint Committee on Terminology, representing the American Institute of Accountants, the American Society of Mechanical Engineers, the American Management Association, the National Association of Cost Accountants, the Society of Industrial Engineers, and the Taylor Society, acting through a sub-committee consisting of R. T. Kent, Chairman, J. D. Hackett and Edward H. Moeran. The table herewith printed represents a consolidation of the work of the various parties interested.

—THE EDITORS

Introduction

THE Decimal Classification of Melvil Dewey and the expansion of it which was prepared by the International Institute of Bibliography at Brussels, are schemes for the classification of all branches of knowledge. Both schemes provide a special place for the classification of the literature of business management, but there are many other portions of these schemes which deal with topics of interest to those who are engaged in business enterprises.

The present publication is an attempt to provide a convenient guide for classifying the material usually wanted in a business collection, by bringing together the appropriate classes, with their correct symbols, and eliminating those which are not relevant. It is, in brief, an excerpt from the complete tables, to which reference can be made for additional information when collections become large enough to require closer subdivision. The original class numbers are used in the present work, so that such expansion may be made easily.

All subjects which contribute to business in its economic and financial aspects have been retained, also all trades, industries, professions, and commodities used in trade. Engineering subjects contributing to plant maintenance are also included.

If it is necessary to divide by country, reference can be made to the full Dewey tables.

In the usual case, the most used classes will be 651—658 and 659.1.

If further subdivision of any class is needed, it is often possible to accomplish it by combining two class numbers. For example, articles on Cost accounting for an Automobile plant take 657 : 629.113, and Mechanical handling of coal takes 658.281 : 662.65.

The Class 658 has been called Management or Business Methods. It is the method of management applied to stores, manufacturing plants, or any form of business enterprise.

Many, if not all of these methods, are common to every type of business, making the 658 group one which must constantly be used in connection with other parts of the scheme. For example, Methods of Management used in Textile mill takes the number 658.9 : 677. Again Operation Studies carried on in a Textile Mill takes 658.542 : 677, giving emphasis to the Management side; or, the numbers may be reversed 677 : 658.542, giving emphasis to the industry side; or, both may be used if it is desired to index in both ways.

Index

The index contains many subjects not included in the Classification Scheme because of lack of space. Names of trades and articles manufactured are listed here as well as all subjects mentioned in the tables. The numbers in the index are the numbers in the *full* classification scheme, e. g., Artificial flower industry takes the no. 688.4 which is a subdivision of the class 688 in the main table.

Form Numbers

It is frequently desirable to qualify a subject by the *form* in which it is presented as, Statistics, Cost, etc. In order to show this the following Form Numbers may be added to any number:

Example: 62(003) = Engineering Standards

(001) Statistics
(002) Quantities and Costs
(003) Contracts Specifications Standardization
(004) Designs Drawings
(005)
(006)
(007) Laws and Regulations
(008) Patents
(009) Reports (Official)

(01) Theory: Efficiency
(016) Bibliography
(02) Handbooks Forms
(03) Dictionaries

[1] This article is one of a series which gives in concise factual form standardized methods and accepted practice generally applicable in industrial operation.

* Numbers marked with one star are taken from the Brussels expansion of Dewey.

(04) Essays
(05) Periodical
(*058) Directories Year books
(06) Societies Congresses Conventions
(07) Education Teaching
(*072) Research
(*083) Tables and Calculations
(09) History

Outline

016—174 General
3 Sociology Economics
51 —55 Mathematics Physics Chemistry Geology
6 —64 Useful arts Engineering Agriculture Domestic Economy
65 Communication Business
651—656 Office Methods Transportation Communication
657 Accounting
658 Business methods Industrial management
659.1 Advertising
66 Industrial chemistry
67 Manufactures
68 Trades
69 Building trades
7 Fine arts
92 Biography

Table of Class Numbers

See Introduction for Form Numbers

016 Subject Bibliography

All bibliographies may be classed here divided by subject, as 016.62 = Bibliography of Engineering; or they may be classed with the subject first, as 62(016) = Engineering Bibliography.

150 Psychology

For Trade tests, see 658.311563

174 Professional and Business Ethics

Includes questions of honor and dishonor in business

3 Sociology

309.1 Social surveys

31 Statistics

311 Statistical methods. Index numbers

32 Political Science

Theory of state and government

323 Internal relations with groups of individuals

Free speech—Liberty of the press.

323.6 Citizenship

324 Suffrage

325 Immigration

33 Economics. Political economy

331 Labor and laborers. Employers. Capital

This is for economic phase only. For the question of labor and labor relations within a specific business see 658.3. All Personnel questions should be classed in 658.3
May be divided by trade as: Labor in Iron & Steel industry. 331:669.1

.1 Relations of capital to labor
331.15 Labor relations

For Labor relations within the plant, see 658.315

.151 Industrial democracy. Representation in industry
.153 Conciliation
.154 Mediation
.155 Arbitration
.156 Joint conferences
.157 Trade agreements
331.2 Remuneration for work. Wages

For Wages within the plant, see 658.32

.21 General
.214 Economic theory of wages
.215 Fixing wage rates. Minimum and maximum wage
.2153 Relation of wage to production
.2154 Relation of wage to cost of living. Living wage
331.22 Wage scales: scale contracts. Sliding scale
.23 Basis for wages. Methods of payment
.24 Profit-sharing
.25 Pensions. Insurance. Benefit agencies

See also 658.325 and 368

.26 State and wages
.261 Legislation. Laws
.262 Wages for state labor
.27 Professional remuneration
331.3 Labor of children
331.4 Labor of women
331.5 Work under certain unfavorable conditions. Reduced labor; compulsory labor
.51 Prisons. Convict labor
.54 Contract labor
331.6 Pauper labor. Cheap foreign labor

See 325 Immigration

331.7 Different classes of workers. Skilled and unskilled
.71 Intellectual or mental work
.713 Liberal professions
.714 Artistic workers
331.8 Laboring classes

See also 658.38

.81 Duration of work. 8-hour day, etc.
.82 Working conditions. Places of labor. Hygiene—Accidents, etc.
.825 Employer's liabilities. Reparation

As applied in special industry, see 658.3825

.8255 Workmen's compensation
.827 Improvement of working conditions in factories, stores, offices, etc.
331.83 Economic conditions of workers. Material needs

Budgets Stores Lodgings

331.84 Morals and habits: Thrift, temperance, amusements, etc.
331.85 Intellectual life. Education
.852 Social settlements
331.86 Industrial education. Training

For Training within the plant, see 658.386

331.87 Organization of labor

Division and concentration of labor
Specialization. Co-operation.

331.88 Trade unions and other labor organizations
.882 Unions of managers
.883 Mixed unions of managers and workers
.886 Revolutionary unions
.8862 Syndicalism
.8863 Bolshevism
.8864 I. W. W.
.888 Unions of women workers
.889 Compulsory unions

Open vs. closed shop.

** Numbers marked with two stars are those used in the Engineering Societies Library, but not yet printed in either scheme.

331.89 Disagreements beween capital and labor
.891 Attacks on freedom of work
Picketing. Scabs.
.892 Strikes
.89201 Causes
.8921 Union strikes
.8922 Sympathetic strikes
.8923 Unorganized strikes
.893 Other methods of workmen
.8931 Violent
Sabotage
.8932 Mild
.8933 Boycotting
.8936 Unfair lists
.8937 Fair lists
.894 Methods of employers
.8942 Blacklisting. Laying under interdict
.8943 Whitelisting
.895 Lockouts
331.9 Other questions
.91 International regulation of labor
.92 Right to work. National shops and yards
.97 Encouragement to work. Medals, decorations, rewards
.99 Intervention of public powers in general
.991 Transport of workers. Workmen's trains

332 Financial economics
For Financial control of business from the management side, see 658.14
For Accounting, see 657
.04 Financial crisis
.1 Banks (General)
.2 Savings banks
.3 Loans on securities. Institutions and operations
.4 Money, Coins and coinage
.42 Single and double standard
.43 International standard
.45 Comparative value of moneys. Exchange
.5 Paper money
332.6 Stocks and stock exchanges. Financial markets. Bonds
*.63 Transferable securities
.7 Credit
Credit system, see also 658.882

333 Land: ownership, rights, and rent. Conservation of Natural resources
See also 338
.1 State ownerships
.2 Community ownership
.3 Private ownership
*1 Family property, 2 Workmen's houses and gardens, 3 Mortgages, 9 Real Estate
.5 Rent of land for cultivation
.6 Rent of land for building
.7 Special classes of land, forests, pasture, waste
.8 Mines

334 Co-operation. Mutuality
.1 Building societies
.2 Co-operation banks
.3 Insurance companies
See also 368
.4 Co-operative housekeeping
.5 Co-operative stores
See also 658.8832
.6 Co-operative production (workmen's cos.)
.7 Friendly societies. Thrift. Mutual aid
See also 658.384
*.71 Sick funds

335 Socialism. Communism

336 Public Finance
.2 Taxes
.21 Direct
.22 Real estate
.23 Personal property
.24 Income tax
For Accounting methods, see 657.455
.25 Poll tax
.26 Customs. Duties
See also 337 Protection
.27 Excise, license, special taxes
.28 Local taxes
.29 Assessment and collection of taxes. Exemptions

337 Customs. Protection and free trade
For customs laws and tariffs on various specific articles, divide by the class no. of the articles, as 337:669.1 = Duty on steel

338 Production. Industrial Economics
For Production within a plant, see 658.5
.1 Agricultural products
.2 Mining products
.3 Water products = Fish, ice, etc.
.4 Manufactured products. Factories
.5 Prices and values
For prices of special commodities divide, as 338.5.633 = Prices of grains
*.58 Calculation of the net cost. Expense of production. Price analysis
338.6 Gilds. Co-operation organizations of production
.8 Production monopolies. Trusts
*.91 Various elements or factors in production—Wealth—Land—Machinery, Patents, etc.
*.93 General organizations of enterprises
*.94 Division and concentration of labor. Use of machinery
*.95 Systems of running enterprises Leasing—Working on shares, etc.
*.96 Size of undertaking. Large—Small industry
*.97 Industrial crisis. Scarcity, overproduction
See 332.04 Financial crisis
See 380.04 Commercial crisis
*.98 Intervention of the state in production

339 Consumption of wealth
*.2 Division of wealth
*.3 Estimation of wealth. Capital and income
*.4 Consumption. Use of wealth

347 Private law
Put law of special topic with the subject, as water-supply Laws, 628.1(007)
*.19 Corporation law
.2 Real estate
*.23 Property condemnations
*.2341 Franchise
*.27 Mechanics liens
.4 Contracts
*.5152 Workmen's compensation law
See also 658.38255
*.56 Licenses
.7 Commercial and Maritime law

360 Associations and Institutions
Hospitals. Clubs. Prison, etc

368 Insurance
See also 658.325
.1 Fire
.2 Marine
.3 Life
.4 Accident, Liability
See also Workmen's Compensation 331.8255 and 658.38255
.5 Animal and crop
.6 Plate glass

.7 Boiler, Machinery
.8 Credit and bonds. Land titles

37 Education, Teaching profession
See 6(07) for Technical education.
See 658.386 for Training within a special business.

38 Commerce. Trade
Class here works which treat the subject from an economic or social standpoint. The technique is classed in 650.

*.01 Theory
38(06) = Trade associations
38(061) = Boards of Trade.
*.011 Supply and demand
*.012 Markets in general
*.04 Commercial crisis
See also 332.04 Financial crisis
See also 338.97 Industrial crisis

381 Domestic trade

382 Foreign trade, Importing, Exporting. Consular reports

389 Weights and Measures

51 Mathematics

53 Physics

54 Chemistry (Pure science)
See 660 for Industrial chemistry

6 Useful Arts

608 Patents, Inventions, Trade-marks

61 Medicine

613.6 Hygiene of employment

614 Public Health

614.7 Air pollution, Industrial
614.8 Industrial accidents
Safety devices and measures, see also 658.283

617.6 Dentistry

62 Engineering

620.1 Strength of materials. Engineering materials. Tests

621 Mechanical engineering

.1 Steam engineering
**.101 Steam power-plants
.18 Steam generation and Transmission
Fuels—Furnaces—Boilers, Stokers, etc.
For Power factor within the plant, see 658.26

621.2 Hydraulic engines or motors Water wheels, Turbines, etc.
621.3 Electric machinery. Industrial electricity
.31 Electric power production
**.31003 Super-power systems
*.311 Electric and hydroelectric plants
.32 Electric lighting. Illumination
See also 658.24. See also 628.9 and 665.7
.33 Electric traction
*.34 Electric drive
.38 Electric communication
.382 Telegraph
.384 Radio. Wireless
.385 Telephone
621.4 Air and Gas engines. Internal combustion engines
621.5 Pneumatic machinery. Refrigeration
621.6 Blowing and Pumping engines
651.7 Mills—Factories, etc.
Use 658 for plant management.
*.71 For shop maintenance See 658.5
*.72 Foundry
.73 Forge shop
*.74 Wood working shops. Pattern-making
*.75 Designing and drafting-room practice
.76 Metallurgical works
621.8 Power transmission
.81 General machine design
.82 Shafting. Bearings
.83 Toothed gears and cams
.84 Valve motions
.85 Machinery and Mill gearings. Belts, etc.
.86 Hoisting and conveying machinery
See also 658.28
.87 Cranes and elevators
.88 Fastenings, Screws and bolts
.89 Lubrication. Lubricants
621.9 Machine tools
.91 Planing and milling machines
.92 Grinding and Filing. Abrasives
.93 Cutting and sawing
.94 Turning lathes
*.944 Rolling mills and milling
.95 Perforating, Drills
.96 Punching and shearing
.97 Hammers, Riveting tools
.98 Bending, straightening and shaping
*.99 Threading and Screw cutting

622 Mining engineering

623 Military engineering

624 Structural engineering. Bridges, Arches
.9 Roofs

625 Railway and Road engineering
.1 Railroad construction
.2 Rolling stock
.3 Mountain railways
.4 Elevated and underground, Subways
.5 Cable roads
.6 Street railways. Feeder lines
.7 Roads, Streets, Highways
.8 Pavements, Paving

626 Canal engineering
.8 Irrigation works

627 Rivers, Harbors, General Hydraulic engineering
For Hydraulic machines, see 621.2
.9 Lighthouses

628 Sanitary engineering
See also 658.239
.1 Water works.
See also 658.238
.2 Sewerage works
.3 Sewage and its disposal
.5 Industrial sanitation
See also 658.239
.51 Factories and trades.
1 Prevention of dust and fumes—2 Protection of throat and eyes—3 Protection against infection.
.52 Effluvium nuisances
.53 Smoke nuisance
.54 Disposal of liquid and solid wastes. Factory wastes
.6 House drainage
.8 Ventilation
See also 658.25

.9 Lighting.
See also 658.24

629.1 Automotive industries
*.113 Automobile industry
*.12 Marine engineering. **Shipbuilding
.13 Aeronautics

63 Agriculture. Farming

631.3 Farm machinery

633 Grains, Cereals, Vegetables

634 Fruits, Orchards, Vineyards
.9 Forestry

635 Market gardening

636 Stock raising
.5 Poultry.

637 Dairy and dairy products
.1 Milk
.2 Butter
.3 Cheese

638 Bee culture. Silk worms, etc.

639 Hunting and Fishing industries. Trapping

64 Domestic economy

648 Laundry industry

65 Communication—Business. (General)

**650.6 Public Utilities

651 Office economy
See also 658
.1 Office building
651.2 Equipment
.22 Fixtures
Partitions, counters, etc.
.23 Furniture. Chairs, Tables, etc.
.24 Furnishings and decorations
.26 Mechanical appliances, Telephones, etc.
Dictating machines
.264 Calculators—Adding machines
651.3 Organization within the office.
Better to class all organization material in 658.16
.34 Office employees
.37 Grades and Titles
.372 Office manager
.373 Dept. heads
.374 Bookkeepers, Stenographers, etc.
651.4 Administration within the office.
Better to class all material in 658.3 and its subdivisions.
651.5 Records. Files and filing.
.51 Form of records: Books—Cards, etc.
.52 Mode of production—Machine—Automatic
.53 Arrangement. Classification.
.54 Storage methods
.55 Accessories.
For Furniture, see 651.23
.56 Permanent records. Statistics.
.57 Temporary records. Ticklers, etc.
651.6 Special material
.62 Specifications
.63 Estimates
.64 Plans—Drawings—Maps
.65 Printed matter issued by office.
Order blanks, etc.
.66 Employees records
.67 Letter files
.673 By subject
.675 Removals
.677 Copies of outgoing letters
.678 Transfer files
651.7 Correspondence
.71 Stationery
.72 Blanks
.74 Style. Business English
.75 Letters—Form letters—Follow up, etc.
.76 Notices. Calls for meetings.
.77 Minutes—Committee business
See also 651.72
.78 Reports.
Organization of material—analysis.
Transmission and introduction.
Recommendations, etc.

652 Writing. Material—Methods—Cipher
*652.3 Typewriting.
For the Manufacture of Typewriters use 681.6
*.35 Duplicating and copying processes.
Photoprinting.
For Designing and Drafting-room practice, see 621.73

653 Shorthand. Stenography

654 Telegraph
For engineering, see 621.38; for Codes, see 652.
.5 Cables
.6 Telephone
.7 Alarms, burglar, fire.
.8 Speaking tubes. Pneumatic tubes.
.9 Signals.

655 Printing trade
.5 Publishing, Bookselling

656 Transportation
May be used in relation, as 656:662.65 = Transportation of coal.
For Transportation methods within the plant, see 658.281
*.11 Street traffic
*.124 Motor trucking
*656.2 Railroads Transportation.
*.21 Railroad stations.
*.212 Railroad Terminals
*.22 Train operation.
*.23 Rates. Freight rates
*656.4 Elevated and street railroads, Subways.
*.6 Shipping, Navigation.
For Shipping methods, see 658.788
*.62 Inland navigation.
Water transport
**.65 Ferries
*656.81 Postal service

657 Accounts—Bookkeeping
Use in relation with industry, as 657:665.7 = Accounting for Gas companies
*.2 Bookkeeping
*.24 Commercial documents
Invoices—statements—bills of lading
*657.3 Various books and original records
Cashbooks—journals—ledgers
*.37 Inventories
*.372 Profit and loss. Balance
*657.4 Accounting practice
*.41 Capital accounts
*.42 Assets—Valuation—Depreciation

*.421 Fixed assets
Raw material—Depreciation of plant
*.422 Current assets. Floating or liquid assets
1 Accounts receivable
2 Accounts payable
*657.423 Operating assets
Syndicate profits
Time transactions
Work in process
*657.4236 Good-will
*657.43 Personal accounts
*657.44 Expenditures and receipts
*.441 Overhead expenses
*.442 Incidental profit and loss
*.443 Commissions and interest
*.444 Sales accounts
*657.45 Other accounts
*.452 Cost accounts
*.453 Sinking fund
*.458 Statements conforming to special requirements.
State supervision—Tax blanks
*657.7 Public accounting. Auditing.
*.72 State control. Certification of accountants
*.74 Verification of accounts
*.79 Reports and certificates of accounts

658 Business Methods. Industrial management
For Office methods see 651—For Accounting see 657—For Advertising see 659.1
For material on management of a specific business, see notes under 658.9
.01 Theory Business efficiency, or use 658(01)

658.1 Generalities
.11 Promotion
.112 Location
.113 Developing interest: prospectuses
.114 Forms of enterprise
1 Individual proprietorship
2 Partnership
3 Limited partnership
4 Stock companies
5 Corporations
6 Business trusts
.12
.14 Finance—Financial control—Budget making
.15
.16 Organization

658.2 Plant. Building and Layout
.21 Location site
.211 Climatic conditions
.212 Land value
.213 Labor availability
.214 Transportation facilities
For transportation within the plant, see 658.281
.215 Availability of raw material
.216 Proximity to market
.217 Source of power
.218 Site
With reference to space, air, light, soil, slope of ground, etc. Includes occupancy of buildings used partly for other purposes.
.219 Other
.22 Material
.23 Design
.231 Future expansion
.232 Relation to product
.233
.234 Floor space
.235 Storage facilities
See also 658.78
.236 Office space
See also 651
658.237 Service facilities
Rest rooms, cafeterias, hospitals, see also 658.28
.238 Water supply
For water-supply engineering, see 6281.1
.239 Sanitation
.24 Lighting
See also 628.9 for lighting in general, 621.32 electric lighting, 665.7 gas lighting
.241 Natural
.242 Artificial
.25 Heating and ventilating
See also 628.8 for heating and ventilation in general, 697 for methods of heating and installation
.26 Power in the plant Power control
.261 Power generation
.262 Power transmission
1 Belting
.27 Production equipment
658.28 Service equipment Labor-saving devices
.281 Transportation Conveyor systems Handling materials Trucks
1 Hand conveyors and hoists
2 Power conveyors and hoists
3 Gravity conveyors and hoists
For conveying and hoisting machinery, see 621.86
.282 Sales equipment
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For Safety measures (Personnel), see 658.3823
.284 Fire protection and equipment
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2 Hose
3
4 Automatic
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658.3 Personnel Labor and laborers Employers Capital
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658.31 Relations of capital to labor
658.311 Labor contracts in general Employment (i. e. engaging workers)
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658.3112 Labor supply Agencies
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3 General education
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.3115 Selecting workers
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11 Employment bureaus Agencies
12 Advertising
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5 Character analysis
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658.3116 Engaging Workers
2 Individual bargaining
3 Collective bargaining Representative bargaining

658.312 Department organization
.3123 Service records Testimonials
.3124 Staff Grades Titles and duties
2 Officers: executive, director Heads of enterprise
3 Staff: department, division and section heads
35 Understudies, deputies
4 Employees, routine workers

658.3125 Labor maintenance
2 Follow up
3 Transfers
4 Promotions
5 Rating of worker

.3126 Turnover
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2 Calculations
9 Statistics

658.313 Termination of labor Unemployment Reemployment
.3131 Causes Legitimate grounds
.3132 Warnings
.3133 Indemnities
.3134 Cancellation of contracts
.3135 By employer
2 Layoff
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.3136 By employee: quit
.3137 Unemployment
8 By industry
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658.314 Rules for workshop and office employees Incentives Discipline
.3141 Conversation
.3142 Personal calls or work
.3143 Soliciting money, subscriptions, contributions
.3144 Respect and care for property (tools, etc.)
.3145 Personal appearance, dress, uniforms
.3146 Courtesy Indifference
.3147 Incentives
2 Suggestions for systems
.3148 Discipline
2 Fines
3 Stoppage of wages
6 Stoppage of privileges

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2 Joint board of control
3 Works council
4 Works committees Shop committees
5 Company unions
.3153 Conciliation
.3154 Mediation
.3155 Arbitration
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.3157 Trade agreements

658.316 Jurisdiction over work Industrial and professional tribunals

658.317 Patronal institutions favoring the personnel
.3171 Funds for pensions and for aid in general
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658.32 Remuneration for work Wages Wage systems
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.3211 Payment of wages Mode (e. g. cash or check), place, time, pay-rolls, paybooks
.3212 Stoppage, deduction, withholding
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.322 Wage scales: scale contracts, sliding scale
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.323 Bases of wages and kinds of payment
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.3232 By time: hour, day, week, month, year
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.3236 Intervention of middleman
Subcontract, sweating system, commissions
.3238 Payment by other than employer; fees, tips, etc.

658.324 Profit-sharing
.325 Pensions Insurance Benefit agencies
.3251 Pensions
.3252
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.3254 Individual insurance
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658.34 Labor of women

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3 Prevention of occupational diseases
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5 Nursing
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71 First aid
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.3831 Cost of living
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.3832 Co-operative stores
.3833 Dwellings
658.384 Morals and habits: thrift, temperance, amusements, temptations
658.385 Intellectual life
.3853 Libraries Reading-rooms Employee publication
.3855 Lectures Demonstrations, etc.
.3858 Continuation schools
658.386 Training
.3861 Apprenticeship
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658.844 Auctions
.845 Sample rooms or exhibits
.846 Commercial travelers (shop to shop, store to store)
1 Salary
2 Commissions
3 Expenses
.847 Canvassers, agents (house to house)
.85 Sales methods. Salesmanship
.855 Display of goods or samples
.856 Exchanging. Rectifying errors
.857 Approval system
.86 Wholesaling. Jobbing
.87 Retailing
.871 Department stores
.872 Mail order houses
.873 Chain stores
.875 Commission business
.876 Brokerage
.877 Branches. Agencies
.88 Collections
.881 Cash
.882 Credit
.883 Instalments
.884 Enforcement measures
.89 Selling applied to special industries
For business having special number preferable classed in the number for that business, but may be classed here with subdivision for the business.

658.9 Specific industries
Divide by industry, as Management of Watch factory = 658.9:681.11
.91 Mercantile business not having special number

659 Other topics

659.1 Advertising
See also 658.82 Trade promotion
*.13 Methods. Appeals
*.131 Newspaper and Journal advertising
*.132 Prospectuses
*.133 Public signs. Billboards. Window dressing
*.1335 Electric signs
*.134 Vocal publicity
*.2 Commercial bureaus of information

66 Industrial chemistry. Chemic technology

661 Chemicals. Manufacture of chemical products
See index for nos. for special products.

662 Explosives. Pyrotechnics. Matches
.6 Fuel: Coal, peat, natural gas, etc.

663 Beverages

664 Foods
.8 Preservation of foods. Canning industry

665 Illuminating Industry
.7 Gas industry

666 Ceramic industries. Glass, etc.

667 Dye and color industries. Bleaching

668 Various chemical industries
See index for specific industry, as soap, glue, perfumery, etc.

669 Metallurgical industries
.1 Iron and steel

67 Manufacturers.
Class in 670 and 680 special manufactured articles of well-defined finished products. 680 is used for the professional trades requiring specialized workers.
See index for special articles manufactured, as, stoves

671 Articles made of special metals and gems
672 Articles made of iron and steel
673 Articles made of brass, bronze and industrial alloys
674 Wood industries
675 Leather and hide industries
676 Paper industries
677 Textile industries
678 Rubber and similar products
679 Celluloid, Amber, etc.

68 Various trades and occupations
See note under 67
See index for specific articles made, as Optical instruments

681 Clocks—Musical instruments
682 Blacksmithing. Edged tools, etc.
683 Metal Working. Locksmithing, etc.
684 Cabinet Work. Carriage Making
685 Saddlery. Shoe-making. Trunks
686 Binding. Gilding, etc.
687 Clothing industry. Toilet goods. Hats
*688 Toy-making. Fancy goods
689 Other industries

69 Building trades
See 624 for Structural Engineering

693 Masonry. Plastering
693.8 Fire-proofing
694 Carpentry
695 Roofing. Slating. Tiling
696 Plumbing. Gas and pipe fitting
697 Heating and ventilation
698 Painting, Glazing, Paper hanging
699 Vehicle building. Car building

71 Landscape gardening

72 Architecture

73 Sculpture

74 Drawing, Decoration
744 Mechanical drawing

75 Painting

76 Engraving
767 Etching

77 Photography
778 Moving-pictures

78 Music

79 Amusements
792 Theatrical industry

92 Biography

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The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 150 magazines; it also includes the publications of some 50 book publishers and professional societies as far as these are of managerial interest to industrial executives. The items are prepared and classified by the Engineering Societies Library in New York City. The decimal number at the right of each item is the index number and indicates the place the article or book will take when filed in accordance therewith in the classified subject scheme. If articles are grouped according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. Photostat copies of any magazine article indexed can be supplied by The Ronald Press Company for a moderate charge. The books and pamphlets indexed can be procured from their respective publishers.

Accounting

Accumulating the Overhead 657.441
A. V. Bristol. National Association of Cost Accountants. *Official Publications*, March 1, 1924, v. 5, no. 12, 11 pp. Gives consideration to both "Accumulating overhead" and "Distribution of overhead," then eliminates all matter strictly related to distribution. A practical demonstration of the method is given.

657.452
The Complete Operation of a Practical Cost System. Arthur H. Gibson. *Factory*, February, 1924, v. 32, pp. 170-172. Limited to cost accounting in the Heat-treating Department. Gives forms and shows how they are filled out and used. To be continued.

657:665.7
Continuous Inventory of Fixed Capital. A. J. Smith. *Gas Age Record*, February 16, 1924, v. 53, pp. 201-202. Outlines the advantages to a gas company in keeping a continuous inventory of fixed capital and the difficulty of reconciling the property with the accounts in the absence of such records. Reproduction expense, including cost of organizing given in detail. Sample page shown from the Concord gas properties inventory, showing how the inventory is compiled.

657.42
Depreciation Depletion and Income Tax Problems. Fergus Mead. *Cement, Mill & Quarry*, February 5, 1924, v. 24, pp. 42-44. "Exhaustion, wear and tear, and obsolescence," a phrase occurring in the Administration Tax law for 1924 is defined and its significance applied to the sand and gravel industry. Practical suggestions and advice are given on depreciation and how it may be determined.

657.42
Is Depreciation the Bugaboo of Your Income Tax? H. Archibald Harris. *System*, March 1924, v. 45, pp. 331-333, 394. An exhaustive article in which the subject is discussed under the following headings: How depreciation varies with contingencies; Is it always wise to take the highest rate?; Some points to remember in figuring depreciation and where the burden of proof is on the government.

657.452
National Sand and Gravel Association. Standard Cost Account Form. *Cement, Mill & Quarry*, February 5, 1924, p. 38. An itemized costs outline submitted by the committee on cost accounting of the National Sand and Gravel Association at its 8th Annual Convention, January, 1924, St. Louis, Mo.

657
The 1923 Year Book of the National Association of Cost Accountants. 377 pp Published by the Association. A report of the proceedings of the Fourth International Cost Conference of the National Association of Cost Accountants held in Buffalo, New York, in September 1923, is given in this book. The topics discussed at the conference and reported in the book are—Methods of Wage Payment as Related to Costs; To What Extent and in What Manner Should Detailed Cost Figures be Given to Department Heads?; Actual Examples of the Advantageous Use of Operating Budgets; On What Basis Should Raw Material be Charged into Production Costs?; Should Plant and Equipment be Depreciated on Cost or Replacement Value?; Should Detailed Cost Work be Centralized in the Head Office?; Relation of Planning and Dispatching to Cost Accounting; How Far Is it Proper for a Trade Association to Distribute Cost Information Among its Members? On each topic there is one or more major articles developing the subject in a practical manner. Following this there is discussion which furnishes considerable useful information concerning practical problems arising in cost accounting work. At the rear of the book appears an alphabetically arranged list of members of the Association and also of members of the Canadian Society of Cost Accountants.

657.42
A Study of Retrospective Appraisals. W. I. Kircaldie. *Black Diamond*, February 2, 1924, v. 72, pp. 121-122. Basic principles underlying establishment of true value of mineral lands. Classification of natural resources. How fair market value is arrived at in appraisal, with an example. First installment of this paper appeared in a previous number of *Black Diamond*.

657.452
Textbook of Industrial Cost Accounting. By Paul M. Atkins. 396 pp. McGraw-Hill Book Company. This book is largely based on the material contained in the author's earlier volume "Industrial Cost Accounting for Executives". Its several chapters are largely devoted to a discussion of the items that enter into the computation of costs such as material, labor, expense, burden, and to the detail methods of securing information regarding these items from the operating records of the organization. The methods are largely based on those of the Taylor system and the illustrations are mostly drawn from a typical Taylor plant. Other chapters deal with recording of costs, aids to cost accounting, and the utilization of cost records. One feature wherein the book differs from most others on this subject is that it dispenses with the short practical exercises dealing with single phases of the subject. Instead of these short exercises, the student using the book is expected to prepare a single comprehensive report covering an entire industrial organization. The form of this report is outlined in the appendix. This method has been used by the author for several years in his classroom work in cost accounting and the present book is the result of the success he has had with the method.

657:665.7
Uniform Classification of Accounts. H. W. Hartman. *Gas Age Record*, February 2, 1924, v. 53, pp. 131-132, 138. This article traces the development for the past 20 years towards the adoption of the uniform classification of accounts for gas corporations, the extent to which it already affects the entire gas industry, the present plans for its further adoption, and the means whereby the local gas companies and associations can co-operate with the A. G. A. in furthering the work. List of state commissions given which have already adopted the national classification with figures showing the extent of progress made.

Advertising

659.1
Co-operative Selling: Is It the Hope of the Small Unit Manufacturer? Don Gridley. *Printers' Ink*, February 28, 1924, v. 126, no. 9, pp. 49-50, 52. Outlines a plan being backed by the Penn Rivet Corporation of Philadelphia, manufacturers of snap fasteners and other notions under the trade name "3-more". Other manufacturers add of their line to this brand name, and by this co-operation there can be conducted co-operative advertising and selling under one name on a department basis.

659.1
How We Tie Up Our Advertising with the Rest of the Business. *System*, March 1924, v. 45, pp. 320-323, 414. "Second in a two article series and based on an ex

haustive study made by the Shaw Bureau of Business Standards among 54 men . . . this instalment goes into such fundamental questions as the place of advertising in the sales program, the merchandising of the advertising, the best time to advertise, and the determination of the advertising budget.''

659.132

Increasing Direct Advertising Returns. By Flint McNaughton. 220 pp. Selling Aid. This book is a concise and complete outline covering the fundamentals of direct mail advertising. It calls especial attention to the possibilities for increasing returns in the shape of orders by the use of return cards, coupons, order blanks, and return envelopes. A large portion of the book covers the development of advertising plans and the considerations which govern the selection of the best methods to fit the needs of a particular business. The various chapters outlining the subjects enumerated above contain a wealth of illustrations of successful devices which have been used by many business men and corporations engaged in different lines of trade.

659.131

The Story-Tellers' Club in Business-Paper Advertising. W. Livingston Larned. *Printers' Ink Monthly*, March 1924, v. 8, pp. 35, 112, 115. Advertising campaigns must first of all be interesting. The first fifth of a dealer advertisement should be such as to command attention. How a number of concerns have introduced the story element and the dialogue accompanied by a picture to arouse interest.

659.133

When the Dealer Can Give You Only Part of His Window. C. B. Larrabee. *Printers' Ink Monthly*, March 1924, v. 8, pp. 26-28. Illus. The need for the manufacturer to plan an adaptable display which can be broken up into units. This can be used both for the entire window and for part of the window when the dealer wishes to display other products at the same time.

Building and Power

658.2845

First Aid Fire Appliances. *Coal Mine Management*, January 1924, v. 3, pp. 32-36, 63-64. Chart. Defines types of mine fires and suggests aids designed to extinguish or localize fires, but not to serve as substitute for automatic sprinklers or fire departments. Characteristics of various hand fire extinguishers are summarized and presented in chart form which is a reprint of that used and distributed by the National Safety Council.

658.26

Gas Power in Factories W. A. Tookey. *Gas World*, February 16, 1924, v. 80, p. 128. Makes comparisons between electric and gas drive and concludes that if gas motors received the consideration electric motors receive, lower cost of working with equal reliability would be obtained. In transmission problems much blame is put on too small pulleys to give sufficient belt speed for the rated capacity of the engine. Author warns salesmen responsible for gas power development to pay more attention to these matters.

658.2

How to Put Flexibility into All-Concrete Factory Buildings. Morgan G. Farrell. *Factory*, February 1924, v. 32, p. 173. Illus. Such buildings can be made flexible by putting in wood floors with underplanking and continuous rail insets. This article is written in answer to one by Mr. Hamilton in November *Factory*.

658.23

Improved Electrical Conduit System. *Buildings*, January 1924, v. 61, pp. 189-194. Illus. Methods used in installing sufficiently flexible systems of floor distribution for light, power, and signal circuits to care for future requirements in industrial plants and other types of buildings.

693.66

Metal Lath as a Protection from Fire. W. Clay. *Buildings*, January 1924, v. 61, pp. 185-187. Shows how metal lath, as a protection for lumber, insures safety in frame buildings at about 2 per cent increased cost.

658.26

Power Plant Auxiliaries and Their Relation to Heat Balance. A. L. Penniman, Jr. *Journal of the American Institute of Electrical Engineers*, February 1924, v. 43, pp. 118-121. Opportunities for economy in the use of power from the main unit for auxiliary drive, this power being applied as directly as possible, together with the use of the maximum economical amount of low temperature steam taken at several points from the main unit. Considers the subject from the point of view of flexibility, ease of operation, and continuity of auxiliary power.

628.1

Relation of Waterworks to Fire Insurance Rates. H. J. Corcoran. *American Water Works Association Journal*, January 1924, pp. 79-85. Presents information which will be of use in operating and planning additions to existing waterworks systems. Encourages use of automatic sprinkler equipment. Author is chief engineer, Iowa Insurance Service Bureau.

658.26

Saving Money in Our Boiler Rooms. H. H. Harris. *American Gas Journal*, February 2, 1924, v. 120, pp. 96, 109. Program followed by a large gas company to save fuel in the boiler-room. Factors which improved the operating efficiency, stopped steam losses, and prevented steam waste from steam-driven machines.

692

The Services of an Architect. C. E. Schermerhorn. *Buildings*, January 1924, v. 61, pp. 211-212. A brief article intended to show the importance of the architect's part in construction work. Discussed under topics: Location; The Sketches; Working drawings and specifications; The Contract and Supervision.

658.26

When to Use Group and Individual Drives. R. W. Drake. *Industrial Engineer*, February 1924, v. 82, pp. 56-60, 106-107. Illus. The first of three articles. After touching on applications where individual drive shows undoubted superiority over group drive, the author considers each of the reputed advantages of individual drive—elimination of overhead shafting, better light, location of machines to suit continuity of manufacturing processes, etc. He comes to the conclusion that these advantages are not so great as commonly supposed.

Economics

332.1

Advertising Good-Will in the Balance Sheet. Ernest Elmo Calkins. *Printers' Ink*, February 28, 1924, v. 126, no. 9, pp. 121-122, 125-126, 129-130. Why good-will built up by continuous advertising is an insurance of future sales, and why the banker therefore should count it as an intangible asset, similar to character in an individual, when he is considering making loans for advertising.

332.63

The Bankers and Investors Manual. Formerly The Manual of Statistics. Edition of 1923-24. 1611 pp. Commercial Newspaper Company. This annual volume gives pertinent financial information regarding nearly 1200 corporations of the United States and Canada most of whose securities are listed on the Stock Exchanges of those countries. At the front of the book is an alphabetical index of the corporations. They are classified according to the nature of their business in this sequence—Industrial, mercantile, financial, public utility and transportation corporations. The last class is divided further into express, steamship, pipe line, railroad and terminal corporations. A short history of each corporation is given and, in most cases, comparative income statements and balance sheets. In addition, considerable other valuable information is given such as funded debt, capitalization, payment of dividends, transfer agents, officers and directors, location of main office and data of annual meeting. Following this section there is a tabulation of securities listed on 13 leading Stock Exchanges of this country and Canada with high and low quotations for the years 1920, 1921, and 1922. At the rear of the book are yield tables for both stocks and bonds and a brief summary of Interest Laws in the United States. The volume is of convenient size for reference purposes and is substantially bound. The fact that the principle sections of the book are thumb-indexed simplifies considerably the location of information.

381.82

Business Morality at the Crossroads. Schuyler Patterson. *Printers' Ink*, February 21, 1924, v. 126, no. 8, pp. 63-64, 68. Shows how the widespread custom of accepting gratuities and honorariums, or ''graft,'' seems to have permeated the business structure from the highest to the lowest, with resultant decadence in morality. ''Must we definitely set forth those things which a man may or may not do when employed?'' States three rules of a code drawn up by W. B. Colver a few years ago.

33

Economic Theory of Industry and Commerce. Hugh Dalton. *Certified Accountants' Journal*, February 1924, v. 16, pp. 34-42. Paper delivered at a meeting of the London Association of Accountants, October 19, 1923. Remarks based on five principles necessary for raising the general level of economic welfare—increase of production per head, more equal distribution of things produced, reduction of subjective costs of production (cost to individuals measured by fatigue, sacrifice, etc.) more equal distribution of subjective costs, and greater steadiness of incomes and of employment. Followed by discussion, bringing up the questions of destruction of wealth during the war, reparations, inflation, and stabilization.

33

Economics for Everyman. By James Edward Le Rossignol. 323 pp. Henry Holt and Company. In the preface the author states that the purpose of the book is to be a presentation of the economic life of man as a part of a broader social life, with its historical background and its foreshadowing of the future. This purpose has been accomplished with a very strong historical touch. The origin, growth, and present state of numerous economic factors is given with frequent use of examples, considerably increasing the reader's interest. Some space has been given to discussion of abstract principles, but the greater portion of the book deals with definite economic factors such as Transportation, Loans and Credits, Capital and Interest, Foreign Trade, etc. It is an interesting exposition of the growth of economic life.

33

The Industrial System and the Price System. F. C. Mills. MANAGEMENT AND ADMINISTRATION, March 1924. v. 7, pp. 337-341. Shows the position of money in the economic system and relation of price to both quantity and quality of commodities. The effects of price disturbance, the factors affecting it at its control, are discussed. A description of the construction and uses of index numbers is given.

33

The Industrial Worker, 1840-1860. By Norman Ware. 240 pp. Houghton Mifflin Company. This work was offered in competition for the 1923 prize offered by Hart, Schaffner and Marx for the best essay on economic subjects and was awarded first prize. Commonly, the period of 1840 to 1860 has been connected with the slavery question. After reading this book, however, it becomes evident that changes of widespread influence in industrial relations were taking place concurrently with the slavery agitation. Quoting the publisher—"The aim of this book is to portray the social and economic conditions underlying the industrial revolts of the 40's; to interpret the purposes of those involved, and their reactions to the new industrialism; and to trace the genesis and evolution of the working class reforms that resulted". The author attains his purpose by giving a detailed record of the pertinent occurrences of the time, quoting extensively from contemporary writings, and summing up and discussing the facts thus presented in an able manner. Because of the limited spread of manufacturing at that time the major portion of the work deals with New England conditions where there was said to be white slavery as evil as black slavery in the South. The principle topics discussed are —the change of payment from a price basis to a wage basis, or from payment for the worker's output to payment of his services; decreasing independence of the worker caused by increasing use of machinery and the change from an itinerant working class shifting between farm and factory to a permanent factory population; agitation for a 10-hour working day; and the growth of trades unions. The book is an interesting and enlightening discussion of industrial conditions during the two decades prior to the Civil War and will prove valuable to anyone wishing to find the origin or trace the growth of many factors affecting labor conditions today.

336.24

Is Depreciation the Bugaboo of Your Income Tax? H. Archibald Harris. *System*, March 1924, v. 45, pp. 331-333, 394. An exhaustive article in which the subject is discussed under the following headings: How depreciation varies with contingencies; Is it always wise to take the highest rate?; Some points to remember in figuring depreciation and where the burden of proof is on the government.

331.6

It Takes Man Power to Operate Quarries. *Cement, Mill & Quarry*, February 5, 1924, v. 24, pp. 19-22. Illus. The author, Secretary of the National State Association, suggests that all organizations urge upon Congress the recommendations sponsored by the National Industrial Conference Board on December 13 and 14. The Resolutions adopted at the Conference are given, followed by an account of labor in the quarry industry in the United States, and a plea to favor immigration that this present labor shortage may be remedied.

665.5

The Oil Trusts and Anglo-American Relations. By E. H. Davenport and Sidney Russell Cooke. 272 pp. The Macmillan Company. In 1880 Admiral Lord Fisher began his now famous agitation for the use of fuel oil in the British Navy. The converts of and successors to Lord Fisher were not content to secure ample supplies of oil for the fleet, but sought to control the oil fields and means of production. They thus put the British government actively in the oil business, a proceeding that profoundly influenced its foreign policy. The present book is a brief history of the growth of the oil industry, with particular attention to the part played by the British government. It traces the influence of oil on governments, and shows how oil profoundly affected the peace negotiations after the World War. The influence of the Standard Oil Company in the settlement of purely European affairs to its own advantage is cleverly portrayed, and although the authors have no evident love for Standard Oil they can scarcely conceal an admiration for the effectiveness of its methods. The book cites official documents which tend to show that Standard Oil used the government at Washington as a catspaw and practically dictated its foreign policy, at least, so far as oil was concerned. This section of the book does not make pleasant reading for Americans, and were it not for recent events most Americans would be inclined to brand it either as untrue or as a suppression of part of the truth to give misleading impressions. However, in view of the revelations indicating possible corruption of government officials by the oil interests one cannot but regretfully admit that there may be a grave suspicion that the author's conclusions are true. The book is a most interesting one and well worth reading from cover to cover. Unfortunately, it but confirms the popular impression that wherever the oily hand reaches, there is found corruption, whether it be an individual or a government that is concerned.

338.97

Prime Costs in the Business Cycle. Alvin H. Hansen. *The Journal of Political Economy*, February 24, 1924, v. 32, pp. 1-14. A detailed analysis of the effects of the business cycle on cost factors. Considers overhead expenses, prime costs (labor and materials), point of lowest unit cost, relation between prices and output, etc. Finds that the costs of materials and labor tend to balance each other, and that the proportion of the value of manufactured products absorbed by these factors remains remarkably constant in all phases of the business cycle, so that the profits and losses which go with the business cycle are due, not to prime costs, but to overhead costs and fluctuations in inventory values.

382

Dumping: A Problem in International Trade. By Jacob Viner. 343 pp. The University of Chicago. This book is an authoritative compilation, the result of a careful analysis of specific instances of dumping gathered from official reports both here and abroad. The term "dumping" is defined as "price discrimination between national markets," and the practice is classified in various ways according to motives, methods, and continuity. Classifications under motive, which is the most important, consist of: disposal of a casual overstock; development of goodwill; elimination or prevention of competition; retaliation; and maintenance of full production with its attendant economies without cutting domestic prices. A history of dumping is given followed by a review of its effects, its profitability, relevant legislation, treaty applications, and similar matter. The book closes with a comprehensive bibliography. It is a valuable compilation for exporters and importers and a textbook for students of economics. It provides useful information for corporation executives and cost accountants in their studies of foreign markets.

338

Saturation? Not if Selling Is Right. An interview by G. A. Nichols with A. R

Erskine. *Printers' Ink Monthly*, March 1924, v. 8, pp. 23-24. Mr. Erskine believes that overproduction, often caused by underconsumption, can be controlled or prevented by better selling, advertising, and co-ordination of manufacturing schedules and seasonal demand.

338.97

Turnover of Deposits a Measure of Business Activity. Carl Snyder. *Journal of the American Bankers Association*, February 1924, v. 16, pp. 471-473, 482. How the rate of turnover of bank deposits, the variations in bank clearings, and an index of the volume of trade in terms of the computed normal rate of growth, become a reliable index of business conditions in terms of percentage of normal growth.

Financial Control

658.14

Methods of Analyzing Financial Reports. J. H. Bliss. MANAGEMENT AND ADMINISTRATION, March 1924. v. 7, pp. 299-304. An informative article giving various methods for analyzing financial reports. Examples are given to illustrate the proper methods for learning what new funds came into the business and from what source; and how such funds were disposed of or used.

658.14

Operating Factory Divisions by Budget. T. B. Fordham and E. H. Tingley. MANAGEMENT AND ADMINISTRATION, March 1924, v. 7, pp. 291-294. Gives in considerable detail the uses that can be made of a properly prepared budget. The advantages attending its use are: forcing executive thought; enabling the executives to understand and share their responsibilities; increases interest; and provides a check on departmental operating efficiency.

658.14

Pricing Policy in Relation to Financial Control. III—Tuning up General Motors. Donaldson Brown. MANAGEMENT AND ADMINISTRATION. March 1924. v. 7, pp. 283-286. A method of price analysis used by General Motors, which, though resting upon a theoretical basis, is wholly practical. It has, as its objective, the highest attainable return commensurate with capital turnover and wholesome expansion with regard to the economic consequences of fluctuating volume.

Fuel

662.6

Fuel Economies in the American Iron and Steel Industry. *Iron and Coal Trades Review*, February 8, 1924, v. 108, p. 224. A summary of a paper on "Economical Use of Fuel in Steel Plants," read by Mr. H. E. Seibert of the Bethlehem Steel Co. before the American Society of Iron and Steel Electrical Engineers. It covers coal consumption and prices in the United States, fuel economy in bee-hive ovens, by-product coke ovens, in blast furnaces, power of varying efficiencies, and installation costs.

662.65(012)

A Practical Classification of Coals. George H. Ashley. *Coal Mine Management*, January 1924, v. 3, pp. 29-31, 56-61; also *Coal Industry*, January 1924, v. 7, pp. 15-18. Scheme is based on a classification presented four years ago and now reduced to its lowest and simplest terms at the suggestion of the Coal Mining Institute of America. Recognizes the three fundamental differences in coal, type, grade, and class, and aims to classify coal of the common or bituminous variety on the basis of the percentage of fixed carbon in a "standard classification analysis."

Industries—Special

658.9:625.2

Car Shop Facilities, Equipment and Practices. H. W. Williams. *Railway Mechanical Engineer*. February 1924, v. 98, pp. 93-94. How to reduce the out-of-service time of modern cars and thereby increase railroad earnings. Treats of the handling of light and heavy repair and suggests calling in single classes of cars and setting aside part of the shop until that series has all received the needed heavy repair.

658.9:665.5

Floating Roofs for Oil Tanks. L. Schmidt. *Petroleum World*, February 1924, v. 21, pp. 74-80. Drawings. Report on type with movable buffers and shoes giving design and operation of this particular type of floating roof. Includes evaporation tests made at the Shaffer Refinery, Cushing, Okla., and fire tests made at the Chicago Bridge and Iron Works, Chicago, Ill.

658.9:665.7

Increasing Industrial Gas Sales. H. O. Loebell. *American Gas Journal*, February 2, 1924, v. 120, pp. 90-94, 109. Discusses the problem of developing the industrial gas business. Shows how, by reducing the cost of manufacture and establishing a rational system of industrial rates, gas can easily compete with other fuels. Points out the need for efficient industrial gas salesman and gives some of the requirements and training they need.

658.9:625.2

Inspection and Maintenance of Freight Cars. *Railway Mechanical Engineer*, February 1924, v. 98, pp. 98-100. Illus. Covers inspection of cars on arrival at the receiving yard, cars coming from connections, cars in classification yard, inspection of cars at miscellaneous loading points, and inspection and repair of cars on repair or shop tract. Article is abstract of a paper read before the Car Foremen's Association of Chicago and at the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association, held at Chicago, October, 1923.

658.9:629.113

Material Handling Is Cut to Minimum in Jewett Assembly Plant. W. L. Carver. *Automotive Industries*, February 7, 1924, v. 50, pp. 281-88. Illus. Facilities for smooth straight-line material flow, as revealed in the progress of the car through the one-story assembly plant of the Detroit-Paige Motor Car Company. The outstanding impressions are the absence of cross flow, the elimination of burdensome handling and the liberal space allowances.

658.9:664.9

The Packing Industry. A series of lectures before the Institute of American Meat Packers. 357 pp. University of Chicago Press. This book gives a good general idea of the scope and problems of the meat food product industry of the United States. The eight lectures comprising it were delivered under the joint auspices of the School of Commerce and Administration of the University of Chicago and the Institute of American Meat Packers, the latter being the trade and research association of the meat-packing industry. The lectures cover such subjects as Live Stock as the Basic Raw Material, History and General Economics of the Packing Industry, The Packing Plant and its Equipment, Packing Operations, Financing the Packing Industry, Science in the Packing Industry, and Distribution of Meat Products. Each lecture is given by an authority on the subject, such as E. A. Cudahy, Jr., in regard to finance, and Arthur Cushman in regard to the packing plant. While devoted primarily to the dissemination of information among those engaged in the packing industry, nevertheless the book contains much that is interesting to the consumer of meat products. For instance, a particularly instructive and informative section is that which discusses the apparent disparity in prices of the meat as sold to the ultimate consumer and the price paid for live stock on the hoof. Taking into consideration the high percentage of exceedingly low-priced product obtained from the animal, the cost to the consumer of the choicer cuts is not excessive. The book is well worth reading, not only by those engaged in the marketing and producing of meat, but also by the layman.

658.9:625.2

Planning Department for Railroad Shops. M. H. Williams. *Railway Mechanical Engineer*, February 1924, v. 98, pp. 106-107. Author briefly surveys the industrial production field as automobile manufacture, electric manufacture, steel mills, and the oil industry and points out what planning has done for them. He urges that similar methods be tried in the railway shop, noting especially the value of improvement suggestions from employees. Article was awarded second prize in the Shop Management Competition which closed September 1923.

658.9:629.113

Problems of Motor-Vehicle Electrical Equipment Maintenance. P. J. Durham. *Society of Automotive Engineers Journal*, February 1924, v. 14, pp. 162-164. Problems of the automobile field electrician are largely caused by poor equipment material, flimsily made horns, inaccessibility of terminal connections and mounting bolts, poor reflectors, faulty wiring, etc. Author is secretary of the Automotive Electric Service Association and made this plea for closer co-operation between equipment manufacturers and car-owners for better service at the Dayton Service meeting.

658.9:629.113

Process of, and Equipment for, Fender and Body Enameling. G. Lefebvre. *Society of Automotive Engineers Journal*,

February 1924, v. 14, pp. 195-208. Illus. A summary of the improvements wrought in the mechanical equipment and the processes employed in the various plants of the Chevrolet Motor Company, one of the companies of the General Motors Corporation. The processes specially described are those for the enameling of fenders and sheet metal parts and cover the application of two coats of an asphaltic base enamel and a subsequent baking at 450 deg. fahr.; in body enameling they cover the application of three coats of similar material and baking at from 290 to 350 deg. fahr. Ovens and other equipment are described and illustrated.

658.9:625.2

Systematic Car Repair Work at Kent, Ohio. G. W. Armstrong. *Railway Review*, January 19, 1924, v. 74, pp. 133-136. Illus. Description of a system of scheduling car repair in Erie Railroad work shop. Organization is outlined which, though author claims it is not the best that could be evolved, has increased output without increased capital expenditure.

Management

651.26

Accounting Machines E. T. Fanning. *The Credit Monthly*, February 1924, v. 26, pp. 20, 44. Shows the accuracy, speed, economy, and wide range of utility, of analysis and accounting machines in credit and other departments.

658

A Critical Analysis of Scientific Management. H. H. Farquhar. *Bulletin of the Taylor Society*, February 1924, v. 9, pp. 16-26. A lengthy exposition on its accomplishments, shortcomings, and future obligations. Pt. 1 carefully presents Mr. Taylor's ideals and theories; many quotations from his works are made with a view to dispersing prevalent misunderstandings. Pt. 2 under heading of Positive Contributions, includes: increased production, improvements in maintenance of quality, industrial peace, high wages, proper working hours, cost methods, operation study, etc. Pt. 3—Neglected Opportunities, discusses the art as distinct from the science of management, labor from the human and organized viewpoint, etc.

621.75

The Draughtsman and the Foundry. F. C. Edwards. *Foundry Trade Journal*, February 14, 1924, v. 29, pp. 132-135. Discusses the place of the draughtsman in the foundry and urges recognition of his importance in the scheme of casting production. He should be thoroughly acquainted with every detail of foundry practice if he is successfully to stake out the course for efficient foundry production. Followed by discussion of paper and author's reply.

Management

658.3234

Factory Pay-roll Control in the Shirt Industry. M. L. Siegel. MANAGEMENT AND ADMINISTRATION. March 1924. v. 7. pp. 311-315. Control of wage-payment is difficult because operating divisions are usually scattered about in many localities. Methods are given which have been used successfully by one company to overcome this difficulty.

651.26

Figuring 30,000 Gas Bills a Day. *American Gas Journal*, February 2, 1924, v. 120, pp. 89, 98-100. How the People's Gas, Light & Coke Co. of Chicago bills its 720,000 customers. These are divided into 21 groups of about 30,000 each, operated as separate units, the bills of each district falling due on a different day. Describes the operation of the one-line billing machine which makes it possible for one girl to complete from 200 to 250 bills an hour.

658.1

The Importance of Choosing the Right Name for Your Business. Paul K. M. Thomas. *Printers' Ink*, February 21, 1924, v. 126, no. 8, pp. 113-114, 117-118, 121-122. Considers factors entering into the choosing of a corporate name—distinctiveness, fitness, simplicity, etc.—and emphasizes the importance of protection. Concludes that the best source of inspiration comes from the consumers' angle. Cites many instances of change of name.

658

Industrial Management Richard H. Lansburgh. 488 pages, illustrated. John Wiley & Sons, Inc. (Reviewed by G. S. Radford, Consulting Engineer.) The author "aims to present a co-ordinated, simple treatment of the problems, the ideals, and the methods of successful industrial management in a way which is at the same time broad and specific, and which aims to indicate the responsibilities of the factory executives to the workers, the stockholders, and the community". In consequence, the book bears evidence of thorough analysis and careful presentation, which entitles it to a place on the ever-lengthening "five-foot shelf" of management literature. Professor Lansburgh introduces the subject by briefly tracing the historical and economic background; which is the only approach yielding to a thorough grasp of management as it stands today. He then takes up, in greater detail, the main divisions of organization, the manufacturing plant proper, standardization, job-study, wage-payment, personnel relations, and controlling operations. The section on standardization of product and operations and their subsequent maintenance is especially timely. The book is obviously suited to use as a textbook in management courses, and for reference by executives who desire from time to time, to refresh their minds with a general survey of management methods. The fact that they will not always accept the author's viewpoint as to the details of the practical application of these methods, need not detract from the value of such a review. In addition it is suggested that this work may be adopted with advantage as the basis of a stimulating course, in the factory itself, for superintendents and foremen, studying under the guidance of one of the qualified senior executives.

658(085)

Mailing List Directory By Luida H. Morley, Adelaide C. Kight and John Cotton Dana. 727 pp. McGraw-Hill Book Company. A list of some 1500 directories covering 1300 trades is given in this book with the name and address of the publisher of each directory. A good trade directory is nearly indispensable to the manufacturing concern. It is used to determine the actual and potential users of the product manufactured and is especially valuable to the purchasing agent, sales manager, and advertising manager. However, it has been a difficult task to obtain information concerning a directory that will meet any particular requirement. This has been caused by the confusion arising from the titles under which various directories have been published. The information in this book is so arranged alphabetically according to trades, professions, or businesses that it is possible to learn, for practically every mailing list requirement, in just which special directory or in which part of a general directory the desired names can be found. There are twelve pages of instructions for using the book which go into considerable detail concerning the proper procedure for obtaining a solution for any directory problem. The book should prove a valuable addition to the reference library of anyone interested in mailing list directories.

658.353.6

Organizing Industry for Preparedness Against War. Dwight F. Davis. MANAGEMENT AND ADMINISTRATION. March 1924. v. 7. pp. 281-282. An outline, by the Assistant Secretary of War, of what is being done by the government in the way of organizing industry for military purposes.

658.16

Production Control in a Small Organization. G. C. Brown. MANAGEMENT AND ADMINISTRATION. March 1924. v. 7, pp. 305-310. Outlines the steps involved in building up an organization for increasing production and decreasing costs by means of proper control. Emphasizes need for simplicity and concentration in small factory management.

658

Scientific Management and Personnel Work. Mary Barnett Gilson. *Bulletin of the Taylor Society*. February 1924, v. 9, pp. 39-50. Why a scientific management plant offers the proper environment for the highest type of personnel work. The article expounds the four underlying principles of management as presented by Taylor in his "Principles of Scientific Management."

658

Some Plans to Better Management Practice. F. W. Parsons. *Gas Age Record*. February 2, 1924, v. 53, pp. 139-140, 144. The article is general in scope, emphasizing the necessity for broad executive ability from office to factory. It covers time-saving devices and conservation of supplies in offices, the value of research in all lines of business, with skilful utilization of statistics, and foresight required in making promotions and securing a low rate of labor turnover.

651.7

Some Pointers on Writing to Foreign Correspondents. S. W. Dorman. *Printers' Ink*, February 14, 1924, v. 126, no. 7, pp. 112, 115. Gives a few simple rules of

vital importance. The need for understanding the foreigner's methods of doing business and the importance of covering every detail which might be valuable or interesting to him.

Material control

658.7884

Constructing Strong Crates for Machinery. C. A. Plaskett. *Machinery*, March 1924, v. 30, pp. 506-507. Illus. Tests made by the Forest Products Laboratory at Madison, Wis., to derive the most efficient crate to be used by manufacturers for transportation. The crate with the diagonal bracing is especially described. Individuals or companies by referring their wood problems to the Laboratory may obtain a statement of the tests thought necessary and the Laboratory will co-operate in their solution.

658.787

Continuous Inventory of Fixed Capital. A. J. Smith. *Gas Age Record*, February 16, 1924, v. 53, pp. 201-202. Outlines the advantages to a gas company in keeping a continuous inventory of fixed capital and the difficulty of reconciling the property with the accounts in the absence of such records. Reproduction expense, including cost of organizing, given in detail, with a sample page shown from the Concord gas properties inventory, showing how the inventory is compiled.

658.78

Flexibility in Handling Production Material. A. A. Brown. *Society of Automotive Engineers Journal*, February 1924, v. 14, pp. 148-150. A system of decentralization in use by the Chandler Motor Car Company. Material is placed near the place of consumption and in quantities as large as possible. Hand-trucking permitted only where electric or motor trucks cannot gain access. Shortage reports the main index for material purchase. Emphasizes need for men of character and ability to handle this work.

658.783

How We Get Up-to-the-Minute Production Control. C. H. Smith. *System*, March 1924, v. 45, pp. 336-338, 389. Illus. Charts. A very suggestive article showing in detail the clerical operations involved in the manufacturing processes in the Westinghouse Air Brake Company. Shows a decided deviation from old methods.

Mechanical handling

658.281

Around the Shop with the "Electric Mule." H. S. Riggs. *Machinery*, February 1924, v. 30, pp. 438-441. Illus. A description of the trucking system in use in the plant of the Lodge & Shipley Machine Tool Co., Cincinnati. Three wheeled storage battery tractors or "electric mules" are used for pulling one or more lift-trucks on which special platforms and trays for holding work can be built up to any height. In this plant, covering 200,000 sq. ft., this system has been found to be most satisfactory in keeping the work flowing smoothly through the plant.

658.281

Continuous Versus Intermittent Conveyors and Handling Methods. George Frederick Zimmer. *Cassier's Industrial Management*, February 7, 1924, v. 11 (new series), pp. 77-80. Impartial comparison between continuous conveyors and intermittent conveyors employed for distances not exceeding 1000 ft. Shows the advantages of both systems, but concludes that, wherever applicable, the continuous system is superior to the intermittent.

658.2813

Mechanical Foundry Minimizes Labor. J. E. McDonald. *Iron Age*, February 28, 1924, v. 113, pp. 633-637. Illus. Output per man trebled in new plant of the Lavelle Foundry Co., Indianapolis, Ind. Gravity flow and controlled conveyors carry out the theory of a mechanical foundry. Process is described and illustrated by photographs.

658.2813

Mechanical Methods Dominate. D. M. Avey. *Iron Trade Review*, February 28, 1924, v. 9, pp. 601-606. Illus. Diag. Describes the new three-story plant of the Lavelle Foundry Co., Indianapolis, Ind. Carrying out the principles of straight-line routing and vertical direction, plant operations trace a path from the roof to the first floor level by means of a continuous conveyor system. Product at no single stage is "touched by human hands". Photographs and floor drawings illustrate article.

658.2813

Power Conveyors in the Automobile Plant. *Machinery*, March 1924, v. 30, pp. 541-543. Illus. Gravity conveyors and rollways with special emphasis on overhead conveyors. Describes and illustrates their use in the Willys Overland Co., Toledo, O. Japanning conveyors are used in the Durant Motors plant, Lansing, Mich., and are described as continuous conveyors which automatically dip the work in the japanning tank, carry it over dripping pans and convey it through the baking oven.

658.281

Reducing the Cost of Shop Trucking. R. T. Kent. MANAGEMENT AND ADMINISTRATION. March 1924. v. 7, pp. 317-322. A discussion of the shop materials handling problem. The subject of trucking is considered in detail with special emphasis being placed on the production requirements upon a trucking organization; the sources of waste with usual methods; the remedies which will eliminate the waste; and the financial results to be expected.

658.283

Safety Required in Handling Material. D. S. Beyer. *Iron Trade Review*, February 28, 1924, v. 9, pp. 611-612. A general article on the need to save life and time through safety measures with statistical figures taken from a report of the Massachusetts Industrial Accident Board of 1922. Abstract of paper presented before joint meeting of engineering section, National Safety Council and American Society of Safety Engineers, N. Y., January, 1922.

658.281

Studies Savings Effected by Trucks. *Iron Trade Review*, February 14, 1924, v. 74, pp. 479-481. Illus. Operation studies made at the Yale and Towne Manufacturing Co., Stamford, Conn., in the use of platform and dump trucks. Tables of operating data for both types of trucks are given.

622.33:331

Labor Requirements in Bituminous Mines. H. N. Eavenson. *Coal Industry*, February 1924, v. 7, pp. 73-74. Labor required to produce a ton of coal in well-managed bituminous mines, both union and non-union. Information was collected at the request of the U. S. Coal Commission. No data from states south of Virginia or west of the Mississippi River. Gives man-hours for various operations.

621.101

A Modern Colliery Power Plant. *Colliery Guardian*, February 1, 1924, v. 127, p. 274. A discussion of a paper by E. L. Hann describing the plant installed by the Powell Duffryn Steam Coal Co. in Wales. Covers the economic consideration of operation.

Motor Drives for Mine Fans. 621.313
F. W. Cramer. *Coal Industry*, January 1924, v. 7. pp. 8-11. Illus. Comparison of the various types of motors from the standpoint of efficiency, speed, control, initial cost, and power factor.

Power Plant Management. 621.101
Part 4. R. June. *Coal Mine Management*, February 1924, v. 3, p. 55. Diagrams. The economical operation and maintenance of boiler furnaces. Frequent trouble is due to use of inferior refractories—Thick joints between bricks—Cracks in furnace walls—Lack of insulation—and Failure to make minor repairs.

658.9:622

Production Engineering in Coal Mining. T. A. Stroup. *Coal Industry*, February 1924. v. 7, pp. 87-89. A general discussion on what it will mean to introduce mechanical mining methods and the conditions necessary for their success. Considers especially machine loading and layout of mines for mechanical operation.

622.49

Productive Lighting for Coal Mines. C. E. Egeler. *Coal Industry*, January 1924, v. 7. pp. 4-7. Illus. Importance of better illumination underground. Output increased with more light shown by results of illumination production tests. Type of equipment needed for various sections of mine with special reference to the value of Mazda lamps. Illustrated with charts and photographs.

622.91

Some Researches on the Safe Use of Electricity in Coal Mines. W. M. Thornton. *Colliery Guardian*, v. 127, February 1, 1924, p. 273; February 8, p. 341; February 15, p. 407. One object of the writer is to show that not every spark will fire an explosive gaseous mixture. Every engineer knows that only by accurate measurement of the breakdown values of the materials that he uses can safety be insured. In the present work the breakdown point is the current or voltage which just causes ignition, other factors being systematically varied or kept constant.

622.91
Some Researches on the Safe Use of Electricity in Coal Mines. *Iron & Coal Trades Review*, February 1, 1924, v. 108, pp. 180-181. Illus. Describes the principal experiments made by Prof. W. M. Thornton and reported on in a paper before the Institute of Electrical Engineers. Includes signaling balls, shot-firing generators, lamps and ignition by hot wires, ignition by break of circuit, improved lighting in coal mines, etc.

Personnel

658.3861
Apprentice Makes Constructive Suggestions. H. L. Price. *Railway Mechanical Engineer*, February 1924, v. 98, pp. 86-87. Illus. Article was awarded second prize in the competition for regular apprentices of the Sante Fe Apprentice Course. The author tells in what department of the works he thinks the apprentice should start in order to derive the greatest benefit. He approves of giving them responsibility under supervision and points out the advantages of an Apprentice Board over the usual "shop instructor".

658.385
A Comprehensive Plan for Executives' Clubs. S. van T. Jester. *Railway Mechanical Engineer*, February 1924, v. 98, pp. 79-80. An outline of the principles involved and the methods followed in the Jester plan, a new type of industrial club. The membership is limited to men having supervisory duties and who are actively engaged in the industry. Club programs have educational character but are not confined to technical subjects. Plan was tried by two railroad companies with great success.

658.3853
Co-operation through Plant Publications. W. R. R. Winans. *Iron Age*, February 28, 1924, v. 113, pp. 647-649. Suggestions on how employee publications may be made really valuable to both the workers and the management. It discusses methods of securing employee interest, important dont's, how to recognize old employees, and how to report promotions, etc. Article is well written and comprehensive, a distinct contribution to this subject.

62:331.71
The Costs of a Consulting Engineering Practice. By a Consulting Engineer. *The Engineer* (London) February 1, 1924, v. 137, pp. 113-114. Aims to show that the true cost to a consulting engineer of the services he renders consists not only of his personal expenditure plus his office expenses, staff, etc., but also of an overhead in terms of hours due to time spent on necessary but unremunerative work and also to allowance of time lost in holidays and sickness. The author gives particulars of the expenditures incurred by him during the past four years of his practice and indicates them on a diagram showing the analysis of office expenses. Details are given to show how the making of inadequate charges may be avoided.

658.31242
The Executive's Most Important Job. Alvan T. Simonds, James R. Nicholson, John A. Campbell, John R. Clements, M. S. King, Eldridge R. Johnson. *System*, March 1924, v. 45, p. 339. A symposium in which some of the leading executives recite their opinions. Some points covered are: division of time; attitude toward business; exercise and amusements; and relations to his workers.

658.3861
A Foundry Apprenticeship System that Works. H. A. Frommelt. *Open Shop Review*, February 1924, pp. 45-52. Fundamentals of apprenticeship as interpreted by the Falk Corporation, Milwaukee, Wis. Outlines the course as given by them. Classes apprentices into five main groups: 1. "Regulars", boys with a grade school education who spend four years in one department; 2. high school boys spending three years in all the departments; 3. the university apprentice of two years; 4. a group of Marquette University men who alternate monthly between school and shop; and a fifth group or "special apprentices."

658.3
Giving the Employee the Ownership Viewpoint. D. C. Vandercook. *Printers' Ink Monthly*, March 1924, v. 8, pp. 50, 52, 55. The close relation between the work of the man at the factory and the sales program. How a few concerns have shown their employees the value of good work on their part in winning and holding customers.

658.386
Helping the Worker by Education. S. W. Ashe. *Machinery*, March 1924, v. 30, pp. 524-525. Illus. How the evening school at the Pittsfield Works of the General Electric Co. provides educational opportunities for the employees. An enrolment fee of $5 is charged but the fee is rebated at the end of the course for a passing mark of 75 per cent. All the instructors with the exception of the class in public speaking are regular employees.

658.31243
How Can We Develop Good Foremen. *Railway Engineering and Maintenance*, February 1924, v. 20, pp. 69-70. Abstracts of concluding papers in the contest on the selection and training of foremen in track organization. Prize winning papers appear in earlier numbers of this magazine.

658.311
Humanics in Industry. F. W. Parsons. *Gas Age Record*, February 16, 1924, v. 53, pp. 195-196, 200. Growing necessity for securing good management in industry, with special reference to the employment department. Discussion of factors which enter into a company's successful "sale" of employment and causes of excessive labor turnover. Methods of advertising the plant to prospective workers. A general article, not limited to any particular industry.

658.3
Labor Efficiency in Good Times and Bad. N. I. Stone. *American Management Association*, 1923, 13 pp. Address before the Plant Executives' Division, American Management Association, 1923, in which a careful study is made of the employment question and its relation to the business cycle and management.

658.3861
A Modernized Apprentice System. *Machinery*, February 1924, v. 30, pp. 415-418. How apprentices are trained by the Warner & Swasey Company in Cleveland. For 40 years this company has had a regular apprenticeship system in its plant. The training now covers a period of four years and provides not only thorough instruction in all shop processes but also a well-rounded course of classroom studies. A large proportion of these apprentices are retained in important positions, and the system proves of great value in the development and maintenance of a well-trained organization.

658.3225
Practical Ideas from Practical Men. W. Weaver, H. Klieber and H. T. Melling. *Power*, February 26, 1924, v. 59, pp. 337-338. Three brief articles. Bonus system for firemen; points on which a bonus system in the boiler-room should be based. Repairing induction-motor rotor; a device for supporting the rotor to make repairs easier. Eliminating oil vapor from steam turbine bearings; how this was accomplished in one plant.

658.3146
The Responsibility of Management to be Courteous. Amos Bradbury. *Printers' Ink*, February 7, 1924, v. 126, pp. 53-62. Suggestions for improving the quality of courtesy. The responsibility of being courteous to customers and visitors is, according to this author, one which is squarely up to the management. It is the president's job to know how his representatives behave toward the public.

658.31472
A Suggestion Campaign that Really Pays. H. M. Carroll. *Factory*, February 1924, v. 32, p. 162. Proves the value of periodical campaigns. Blanks are distributed to workers by the foremen to show they are behind the plan. Careful consideration is given each suggestion by the Suggestion Committee. Nothing unique about this particular system unless it be its business-like methods.

658.31242
Through the Other Fellow's Eyes. Ruth Leigh. *Business*, March 1924, v. 5, pp. 23, 46, 48. The need for the personnel manager to get the other man's viewpoint, to reach him through his self-interest.

658.3
What's the Connection between a Clean Desk and Good Management? Ed Wolff. *Printers' Ink*, February 21, 1924, v. 126, no. 8, pp. 17-19. The best manager is not a worker but an organizer, who chooses competent men for the various department heads, delegates the work to them, and sees that they work together as a unit. Relieved of details, he has leisure to adjust difficulties and to make plans for the future.

658.31242
Where My Job as an Executive Ends. W. L. Batt. *Factory*, February 1924, v.

32, pp. 151-153. Charts. How one chief executive confines his activities to planning the policies for the business as a whole, turning these plans over to the department managers to execute. Tells of methods used for forecasting. Author believes best results come from negative reports. To correct errors and detect bad methods are the two duties most vital to the executive.

658.31243
Work Without Superintendent. H. R. Simonds. *Iron Trade Review,* February 21, 1924, v. 74, pp. 548-550. Illus. Author feels the pendulum has swung too far in placing management responsibilities on efficiency experts instead of managers, and believes it is time to call a halt. In the plant described 52 foremen control 2500 men, hire men and pay them whatever the foremen think best, and report only to general manager.

Production

658.53
Application of Charts in Industry. D. B. Porter. MANAGEMENT AND ADMINISTRATION. March 1924. v. 7, pp. 329-336. A continuation of a previous article which gives uses and details of construction of various kinds of frequency charts. These include Gantt, machine record, and progress charts.

658.51
Effecting Economies by Regulating Work Flow. A. Whitehead. *Cassier's Industrial Management,* January 24, 1924. v. 11 (new ser.) pp. 35-37. First of a series of articles. How costing reveals production losses. Suggests steps to be taken in keeping records of processes and materials needed, so that supplies at every step may be punctual and adequate, but not in excess.

658.51
How We Get Up-to-the-Minute Production Control. C. H. Smith. *System,* March 1924, v. 45, pp. 336-338, 389. Illus. Charts. A very suggestive article showing in detail the clerical operations involved in the manufacturing processes in the Westinghouse Air Brake Company. Shows a decided deviation from old methods.

658.516
Just How Far Does it Pay to Go with Simplification? Fletcher H. Montgomery. *Factory,* February 1924, v. 32, pp. 153-156, 260. Illus. The Knox Hat Company has made a very careful study of simplification. This article is convincing in showing that one may forecast quite accurately what effect any degree of simplification will have on profits. Engineers were employed to make this study for Knox and their story, as told here, is an interesting one.

658.512
Mechanical Foundry Minimizes Labor. J. E. McDonald. *Iron Age,* February 28, 1924, v. 113, pp. 633-637. Illus. Output per man trebled in new plant of the Lavelle Foundry Co., Indianapolis, Ind. Gravity flow and controlled conveyors carry out the theory of a mechanical foundry. Process is described and illustrated by photographs.

658.512
Mechanical Methods Dominate. D. M. Avey. *Iron Trade Review,* February 28, 1924, v. 9, pp. 601-606. Illus. Diag. Describes the new three-story plant of the Lavelle Foundry Co., Indianapolis, Ind. Carrying out the principles of straight line routing and vertical direction, plant operations trace a path from the roof to the first floor level by means of a continuous conveyor system. Product at no single stage is "touched by human hands." Photographs and floor drawings illustrate article.

658.56
Modern Systems of Boiler Control. J. B. C. Kershaw. *The Engineer* (London). February 8, 1924, v. 137, pp. 141-144. Diag. Charts. Systems of control and bonus payment for boiler firemen and engineers that are fair in operation and do not lend themselves to manipulation or "dodging" by "workshy" boiler firemen. Six systems are described and the plants mentioned in which they have been proved successful.

658.5
Organization of Inspection and Maintenance. F. A. Waldron. MANAGEMENT AND ADMINISTRATION. March 1924. v. 7, pp. 295-297. Continuation of previous articles considering inspection and maintenance departments, gives organization chart and information concerning operating procedure.

658.5
Process of and Equipment for Fender and Body Enameling. G. Lefebvre. *Society of Automotive Engineers Journal,* February 1924, v. 14, pp. 195-208. Illus. A summary of the improvements wrought in the mechanical equipment and the processes employed in the various plants of the Chevrolet Motor Company, one of the companies of the General Motors Corporation. The processes specially described are those for the enameling of fenders and sheet metal parts and cover the application of two coats of an asphaltic base enamel and a subsequent baking at 450 deg. Fahr.; In body enameling they cover the application of three coats of similar material and baking at from 290 to 350 deg. Fahr. Ovens and other equipment are described and illustrated.

658.582
Repair and Upkeep of Pneumatic Tools. R. W. Wilson. *The Engineer* (London), February 15, 1924, v. 137, p. 182. Illus. What is necessary to maintain in efficient operation and in economical service the two classes of tools: pneumatic hammers and pneumatic drills. Covers system adopted for issuing tools to workers and the methods of testing. Gives cost of figures.

658.516
Substitute Materials that Improve the Product. B. M. Maynard and W. S. Powers. *Factory,* February 1924, v. 32, pp. 156-157. Illus. Many concerns have found that it pays to have a committee on specifications made up of a designer, a shop man, and a purchasing agent, to work out the best designs and materials. Describes how one such committee improved products by substituting pressed steel for iron castings, steel and aluminum castings and forgings.

658.5
Ten Small Savings Often Net Us More Than One Large One. C. C. Chesney. *Factory,* February 1924, v. 32, pp. 159-161. Illus. In the foundry described the weekly production corresponds almost exactly with the weekly cost report. This furnishes a means of showing up discrepancies which lead to cost analysis, and this in turn points the way to the elimination of waste in materials and men. Describes some savings accomplished by better handling and the use of special machines.

658.582
A Tool Crib System. M. L. O'Flaherty. *Machinery,* February 1924, v. 30, pp. 428-430. The properly equipped and organized tool-crib department as an important factor in shop efficiency. Briefly outlines a system which saves hours of labor and lost time and prevents unnecessary tool waste.

Selling

658.826
A Composite Picture of Fifteen Salesmen's Manuals. E. B. Weiss. *Printers' Ink,* February 14, 1924, v. 126, no. 7, pp. 41-44, 48. Points to be considered in compiling a manual, as revealed in a brief review of those compiled by the Aluminum Cooking Utensil Co., the Delco-Light Co., the Willys Light Co., the Dictaphone Sales Corporation, and others.

658.83
Co-operative Selling: Is It the Hope of the Small Unit Manufacturer? Don Gridley. *Printers' Ink,* February 28, 1924. v. 126, no. 9, pp. 49-50, 52. Outlines a plan being backed by the Penn Rivet Corporation of Philadelphia, manufacturers of snap fasteners and other notions under the trade name "3-more". A number of notions manufacturers add a brand of their line as the "3-more" brand, and by this co-operation there can be conducted co-operative advertising and selling under one brand name on a department basis.

658.85
Does the Retail Salesman Know Your Goods? Ruth Leigh. *Printers' Ink Monthly,* March 1924, v. 8, pp. 31-32, 80, 83. A thorough knowledge on the part of the sales person of the line of goods he or she is to sell, is the most valuable factor in retail salesmanship. Their knowledge results in self-possession, confidence, enthusiasm, and ability to sell convincingly. Tells how a few companies have instructed their salesmen in the essential points of the goods they sell.

658.8
Giving the Employee the Ownership Viewpoint. D. C. Vandercook. *Printers' Ink Monthly,* March 1924, v. 8, pp. 50, 52, 55. The close relation between the work of the man at the factory and the sales program. How a few concerns have shown their employees the value of good work on their part in winning and holding customers.

658.841
Is Display Room Worth While? F. G. Steinebach. *Iron Trade Review*, February 7, 1924, v. 74, pp. 420-422. Possibility of abandoning expensive stores and conducting the business from offices of machine tool-builders is considered in this article. One dealer claims that only 5 per cent of sales are from floor and 80 per cent after buyer has seen only photographs, circular matter or advertisements. Cites companies who operate without display place.

658.811
Organizing a Sales Department. John Allen Murphy. *Printers' Ink Monthly*, March 1924, v. 8, pp. 17-18, 74. The importance of the general sales manager in building up a selling organization and keeping it keyed up to the ever-growing needs of the company. Touches on methods employed by a few large companies, as the Goodyear Tire and Rubber Co., where the general manager is assisted by district and departmental managers who are responsible to him.

658.82
Putting "Merchandizing" in the Dealers Vocabulary. Dana Hubbard. *Printers' Ink*, February 28, 1924, v. 126, no. 9, pp. 105-108-113. How the Beardslee Chandelier Manufacturing Company puts its sales force to work to teach the retailer to develop his buying and selling into more than haphazard processes; to sell ideas as well as goods, and to increase sales by advertising window display, etc.

658.8
The Responsibility of Management to Be Courteous. Amos Bradbury. *Printers' Ink*, February 7, 1924, v. 126, pp. 53-62. Suggestions for improving the quality of courtesy. The responsibility of being courteous to customers and visitors is, according to this author, one which is squarely up to management. It is the president's job to know how his representatives behave toward the public.

658.811
The Truth About the Salaries Paid to Sales Managers. *Sales Management*, February 1924, v. 6, pp. 497-498. Analysis of information collected by the Dartnell editorial staff. Out of 162 concerns returning their questionnaires, 120 employed sales managers and the average salary of these managers was $7,210 a year. Shows a tendency to consider the sales manager as an all-round executive capable of doing much more than running the sales department.

658.826
Walworth's Method of Regulating Its Sales to Coming Demand. W. C. Mattox. *Printers' Ink*, February 14, 1924, v. 126, no. 7, pp. 3-4, 6, 170-179. The Walworth Manufacturing Company, Boston, with eight selling branches scattered over the United States, keeps the salesmen in touch with everything of importance going on at headquarters, through a sales publication. The company, now in its eighty-third year, studies business economics as a basis for its policies regarding sales, production, and financing, and passes the information on to its salesmen.

658.784
A Warehousing System that Makes Selling and Advertising More Effective. B. A. Fueglein. *Printers' Ink*, February 7, 1924, v. 126, pp. 129-132. Pee Gee paint and varnish is not generally sold through jobbers or distributed from a public warehouse. A sales organization covers every State in which it operates and all accounts with dealers are handled at the main office. Distributing stocks of these products are located in key towns in each state where a distributor operates a wholesale or retail paint store and is constantly building up business for the company.

Technical

665.7
Catechism of Central Station Gas Engineering in the United States. *American Gas Journal*, v. 120.

January 5, 1924, pp. 11-14.
January 12, 1924, pp. 35-38.
January 19, 1924, pp. 59-62.
January 26, 1924, pp. 75-78.
February 2, 1924, pp. 105-109.
February 9, 1924, pp. 125-128.
February 16, 1924, pp. 145-148.

Exact reprint of the "Catechism of Central Station Gas Engineering" originally published in 1909 by the Trustees Gas Educational Fund. The first four instalments approximately cover general introduction, manufacturing materials, and the last three plant construction, operation, retorts, etc. Will be continued in the succeeding numbers of this magazine.

Definitions of Hardness. 6(03)
C. A. Beckett. *Machinery*, March 1924, v. 30, pp. 503-505. Process of hardening and hardness testing are the two viewpoints usually taken by physicists, metallurgists, and engineers. Annotations are given showing use by authorities such as A. H. Tutton, Sir Robert Hadfield, H. P. Hollnagel, W. H. Hatfield and others. The object of this paper is to help establish a universal definition.

621.313
Electric Drives for Mine Hoists. L. A. Umansky. *Coal Industry*, February 1924, v. 7, pp. 75-82. Illus. Charts. Economic comparison of the various systems in use. Discusses induction motor drive and the Ward-Leonard control with fly-wheel motor generator set, with advantages and shortcomings of either system.

Electric Industrial Heating. 621.365
H. M. Drake. *The Engineer* (London), February 1, 1924, v. 137, pp. 114-116. The advance of America over England in the use of the electric furnace for enameling, annealing, and heat treatment of steel is due to the cheap power available in America. Cost of current is the factor which prevents it from being wholly used in England. The high quality of the product of the electric furnace is due to two reasons—the accurate temperature control and the transmission of heat by radiation. The economy in operation and maintenance of the electric furnace is compared with that of the fuel fired furnace, showing electricity to be the cheaper. Tables given showing results of tests run for heat treatment of gun forgings, enameling registers and push buttons, core and wire baking. Diagrams show curves relating to annealing of glass, comparative cost of electrical and carbon heated furnaces, data of temperature distribution in electric furnaces and the design of an electric furnace for heat treatment of steel.

621.3176
Electrical Surveys in Coal Mines. E. B. Stavely. *Coal Industry*, February 1924, v. 7, pp. 68-72. Charts. Portable graphic recording instruments to determine voltage, current, power demand, and power factor conditions in coal mines. Discusses the various applications of graphic meters in the conduct of electrical surveys.

6(07)
Engineering Colleges and Industry. W. E. Wickenden. *American Management Association*, 1924. 11 pp. A discussion of four complaints concerning Engineering Education which indicates a general agreement that it is not now on a satisfactory plane, and a divergence of opinion as to methods for improvement. Raises the question—"What can this association (A. M. A.) do about it?"

621.6423
Floating Roofs for Oil Tanks. L. Schmidt. *Petroleum World*, February 1924, v. 21, pp. 74-80. Drawings. Report on type with movable buffers and shoes giving design and operation of this particular type of floating roof. Includes evaporation tests made at the Shaffer Refinery, Cushing, Okla., and fire tests made at the Chicago Bridge and Iron Works, Chicago, Ill.

658.78844
Formulas for Shipping Box Construction. M. L. Oglesby. MANAGEMENT AND ADMINISTRATION, March 1924. v. 7, pp. 323-328. Gives the derivation of a number of formulas for use in determining proper box construction necessary to withstand forces which will act upon it.

Gas Power in Factories. 621.43
W. A. Tookey. *Gas World*, February 16, 1924, v. 80, p. 128. Makes comparisons between electric and gas drive and concludes that if gas motors received the consideration electric motors receive, lower cost of working with equal reliability would be obtained. In transmission problems much blame is put on too small pulleys to give sufficient belt speed for the rated capacity of the engine. Author warns salesmen responsible for gas power development to pay more attention to these matters.

621.315
Improved Electrical Conduit System. *Buildings*, January 1924, v. 61, pp. 189-194. Illus. Methods used in installing sufficiently flexible systems of floor distribution for light, power, and signal circuits to care for future requirements in industrial plants and other types of buildings.

Improvements in Ice Plants. 621.55
R. C. Doremus. *Universal Engineer*, February 1924, v. 39, pp. 23-28. Describes the latest improvements in plant construc-

tion, methods of water softening, air treatment, three types of air dehydrators, harvesting equipment, electric drive and ice storage, etc. Every process in the ice plant is brought up to date.

620.122

Methods for Analyzing Raw Materials (Data Sheet no. 1-2.) *Forging, Stamping and Heat Treating*, January 1924, v. 10, p. 32 (a). Describes usual procedure followed in steel works to obtain chemical analysis of raw materials. Lists permissible differences in the analyses made by purchaser and purveyor. Outlines various methods in use for steel, cast iron, and pig iron. Will be continued on Data Sheet no. 3.

621.18

Modern Systems of Boiler Control. J. B. C. Kershaw. *The Engineer* (London), February 8, 1924, v. 137, pp. 141-144. Diag. Charts. Systems of control and bonus payment for boiler firemen and engineers that are fair in operation and do not lend themselves to manipulation or "dodging" by "workshy" boiler firemen. Six systems are described and the plants mentioned in which they have been proved successful.

Motor Drives for Mine Fans. 621.313 F. W. Cramer. *Coal Industry*, January 1924, v. 7, pp. 8-11. Illus. Comparison of the various types of motors from the standpoint of efficiency, speed control, initial cost, and power factor.

673.12

Ordering the Right Kind of Sheet Brass. J. L. Christie. *Metal Industry* (N. Y.), February 1924, v. 22, pp. 69-70. Illus. The necessity for accurately defined terms on the part of the manufacturer and specific orders on the part of the purchaser. Gives brief notes on three grades of annealed brass, designated by the American Society for Testing Materials.

691.1

Relative Durability of Native Woods. F. P. Laboratory, U. S. Forest Service. *Buildings*, January 1924, v. 61, p. 203. Technical Note #173. Table giving relative durability (resistance to decay) of untreated woods. Helpful in estimating depreciation.

6(072)

Research the Mother of Industry. A. D. Little. *Michigan Manufacturer*, February 16, 1924, v. 33, pp. 4, 26. Traces the development of research and aims to show that nearly all the great recent developments of science have taken place within the easy recollection of the man still on the job. Gives a few instances showing the value of research in certain specific lines.

625.17

Two Railroads Find Water Pipe Cleaning Profitable. *Railway Engineering and Maintenance*, February 1924, v. 20, pp. 64-66. Illus. Work undertaken by the Northern Pacific involved 17,456 ft. of 10 in. pipe line, requiring 300,000 to 500,000 gal. of treated water per 24 hr. Work costs 31.8 cents per ft. including supplies and labor. The work undertaken by the Chicago, Rock Island & Pacific involved about 300 ft. of 10 in. and 12 in. pipe line. Methods used in both cases are described. Costs are given.

621.18414

Underfeed Stokers and Economy in Coal. Joseph G. Worker. MANAGEMENT AND ADMINISTRATION, March 1924. v. 7. pp. 287-290. Contains a review of underfeed stoker development with problems that have confronted and have been solved by stoker engineers, and a statement of those still awaiting solution.

621.96

Widening Applications of Metal Stamping. Robert I. Miner. *Forging, Stamping and Heat Treating*, February 1924, v. 10, pp. 75-78. Illus. Sheet metal stamping or pressed metals may be applied to widely varying projects in a manner productive of great economies. Modern plants no longer produce rough and semi-ready parts but carry the operation to the inclusion of painting, enameling, galvanizing, etc., until the article is completed. First part of article appeared in January number.

Wood for Auto Bodies. 674.038 A. T. Upson & L. N. Ericksen. *Society of Automotive Engineers Journal*, February 1924, v. 14, pp. 165-170. A statistical summary including charts of the kinds of woods used in the automobile industry. Covers general classification of wood used for cars, wood used for running boards and top-bows, grades of lumber used, present status of body-part size standardization, quality of stock required, utilization of lumber in body plants and suitability of wood for automobile bodies. Authors are of the U. S. Forest Products Laboratory, Madison, Wis.

Transportation

Atlas of Traffic Maps. 656.2 Prepared by Traffic Consulting Staff of LaSalle Extension University, assisted by Charles E. Wymond. 32 maps. LaSalle Extension University. This atlas contains three sets of maps—general, territorial, and railroad. The first group pertains to sources of traffic and the present transportation systems of the United States as a whole. The territorial maps divide the nation into traffic divisions and graphically picture the classification, freight rate association, and rate adjustment territories. The railroad maps illustrate a number of Class I railroad systems in various sections of the country. The maps are so arranged that they gather together in one place and in a form convenient for use much information that heretofore has been available only in circulars, freight tariffs, and other miscellaneous publications issued by the carriers and their agents. The atlas should prove of considerable service to traffic managers and others concerned in the routing of large shipments.

656.2

Departure in Handling Less than Carload Freight. E. F. Ford. *Railway Review*, February 23, 1924, v. 74, pp. 320-321. Describes the Ford plan of consolidation of merchandise at transfer or forwarding stations in rural communities as introduced by the Chicago, Burlington & Quincy R. R. Reduces overtime, loss and damage and conserves equipment.

656.21

Engine Terminal Operation a Difficult Job. E. Gelzer. *Railway Mechanical Engineer*, February 1924, v. 98, pp. 103-105. Illus. Suggestions for improvements in arrangement and in organization of work with a drawing of an improved engine terminal. Author believes that where the arrangement of a combined inspection pit, general office, tool equipment, and oil house can be located near the outbound track it is well also to provide a small shop for light repairs. Article won the first prize in the Engine Terminal Competition of the *Railway Mechanical Engineer*, closed Oct. 1923.

656.124

The Motor Truck and the Railroads. R. C. Wright. *Michigan Manufacturer*, February 2, 1924, v. 33, pp. 3-4. How motor trucks can combine with railroads in the transportation of freight for the less-than-carload traffic. Under ordinary method of handling this traffic by rail, eight handlings are required whereas, if it were conveyed by motor, loading at shipper's door and unloading at door of consignee would cover the handlings. Shows advantages to shippers and points out problems involved in such a scheme.

656.124

Motor Trucks Auxiliary to L. C. L. Service. *Railway Review*, February 2, 1924, v. 74, pp. 218-219. Supplementary railroad freight service by highway transport is of three kinds according to R. C. Wright of the Pennsylvania Railroad system: 1. Freight service in short hauls, less than carload traffic; 2. Supplementing the terminal situation in metropolitan districts; 3. Store-door delivery service. Reports are given of experiments made by the Pennsylvania Railroad and the N. Y. Central R. R., Putnam division.

Co-operation in Transportation. 656.2 F. H. Dixon. *Michigan Manufacturer*, February 16, 1924, v. 33, pp. 5, 24. A discussion of the Federal Transportation Act of 1920. The author believes that this act means the passing of the era of unrestrained competition. Reference is made to the relationship developed in the statute between water and rail transportation and the place of the motor truck is questioned.

Plotting City Schedules. 656.4 C. R. Harte. *Electric Railway Journal*, February 9, 1924, v. 63, pp. 203-205. New method is described by which city schedules of an entire street car system may be seen at one time. Full page diagram given, covering the movements of all cars for one hour, with a specific case described. The effect of schedule changes can be easily visualized by the use of colored threads and beads to represent lines and cars. A satisfactory scheme of studying effects of changes in conditions and of adjustment of schedules to meet them.

Smoke—

—no longer the sign of enterprise

THE cloud of dense smoke that streamed across the top of almost every old-time letterhead was once the pride of thousands of manufacturers—the great symbol of industrial activity.

Then came scientific combustion and public opinion opposing the smoke nuisance. Smoke became the sign of waste and the evidence of law breaking. The "Enterprise" Manufacturing Company joined the hundreds of other concerns that were being forced to change their letterheads—and their ways.

The great wave of public sentiment for smoke abatement proved to be one of the greatest boons to progress that ever swept the industrial world.

It forced industry to a keen interest in scientific combustion!

Power plant owners who sought only a smokeless stack and public good-will, found that along with smokeless operation went reduced coal and labor costs and greatly increased plant capacity. They found, also, that the manufacturers of mechanical stokers had gone intensively into the smoke problem long before the general public had taken it up, and had definitely solved it with *complete combustion.*

All good authorities agree that mechanical stoking is the one certain method of producing the complete combustion necessary for smokeless operation. And the economies of mechanical stoking are so great that the elimination of smoke—although often of first importance—is simply an incidental result!

Many enterprising manufacturers have eliminated the smoke decoration from their letterheads. There are still hundreds, however, that have not eliminated it from their furnaces and stacks who could do so by installing mechanical stokers. The owners, executives and directors of these plants will find a highly informative and timely message in the booklet, "Coal—The Basic Fuel." Have you read it? A copy will be sent you free on request to The Secretary of the Association.

This book *FREE*

BURN COAL

"The *basic* fuel"

STOKER MANUFACTURERS ASSOCIATION

G. A. Sacchi, Secretary, Lester Branch, Philadelphia

STOKER · MANUFACTURERS · ASSOCIATION

SMA

Ten cars of coal—or nine?

Mechanical stokers save coal by increasing furnace efficiency. They also make it possible to burn cheaper grades and sizes of local coal. Ten per cent saving is a conservative estimate.

Five men or three?

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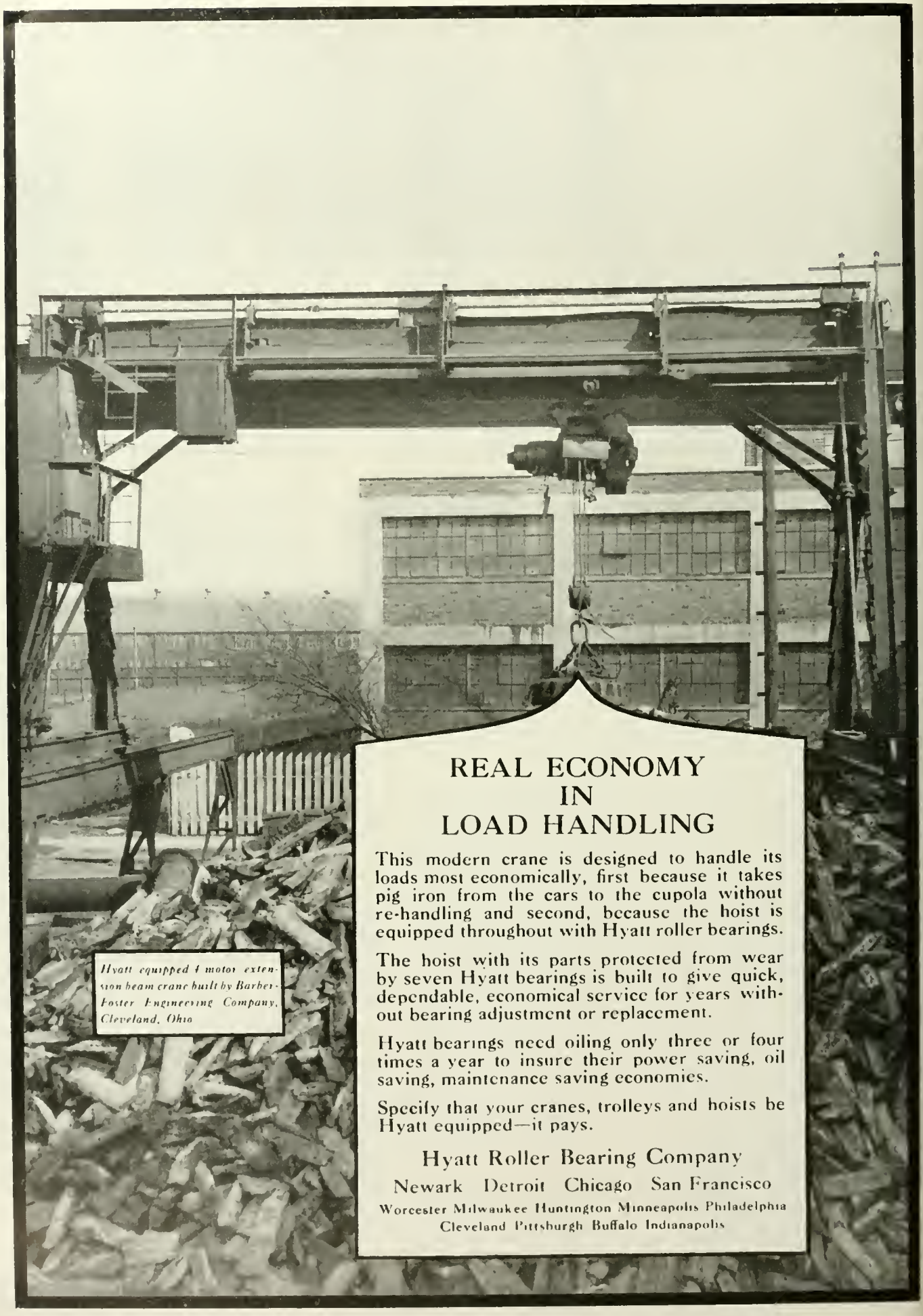

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Group Insurance,.....	467,602,278	Increase	64,696,371
Total increase for the year.....			$385,150,515

NEW INSURANCE in 1923 (not including Group). $584,717,618

An Increase of $89,468,578 over 1922

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CONDENSED BALANCE SHEET DECEMBER 31, 1923

ADMITTED ASSETS		LIABILITIES AND RESERVES	
Mortgages on Dwellings....	$44,183,745 81	Insurance Reserve.....	$570,369,411 00
on Farms	98,195,070 39	All other Liabilities.....	21,572,116 25
on Business Properties...	62,370,456 58	SURPLUS RESERVES:	
Real Estate.....	13,403,568 89	For distribution in 1924:	
Bonds.....	337,339,867 00	On Annual Dividend Policies.....	24,500,000 00
Stocks.....	4,775,115 00	On Deferred Dividend Policies	14,346,000 00
Loans on Society's Policies.	96,941,730 09	Awaiting Apportionment on Deferred Dividend Policies.....	9,161,433 00
Loans on Collateral	682,750 00	For Contingencies.....	46,995,394 02
Cash ($5,572,183 08 at interest).....	5,846,187 22		
Other Assets.....	23,205,866 29		
TOTAL.....	$686,944,357 27	TOTAL.....	$686,944,357 27

The foregoing figures are from the Equitable's Sixty-fourth Annual Statement which will be sent to any address on request.

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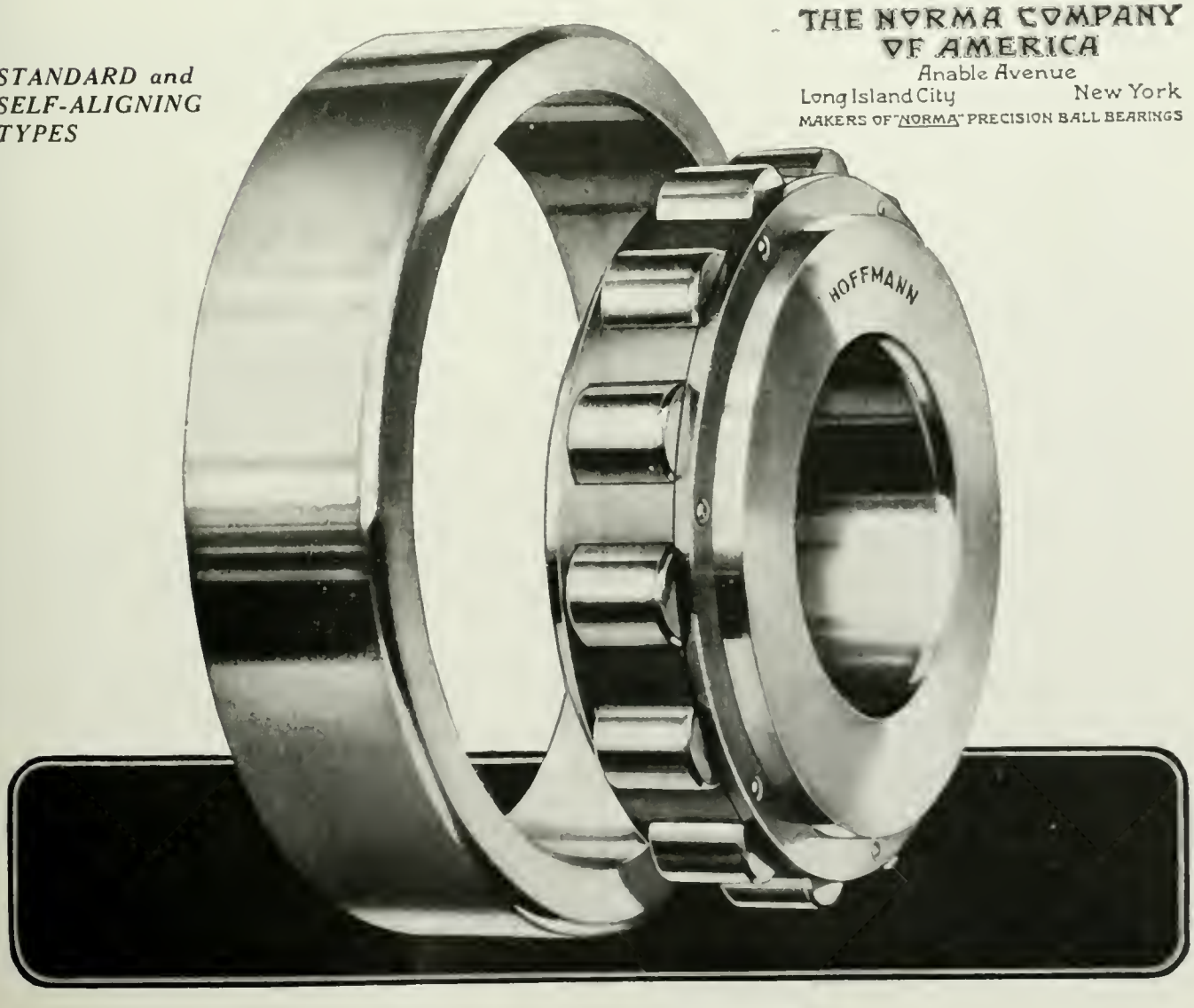

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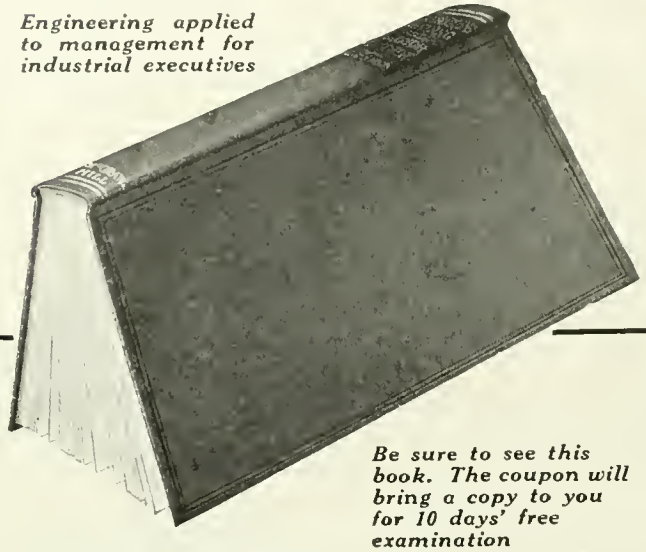

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How to organize a company—
How to set about financing a company—
How to secure good executive control—
Best systems of organizing operating methods—
What the executive should know about cost accounting and its uses—

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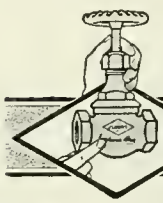

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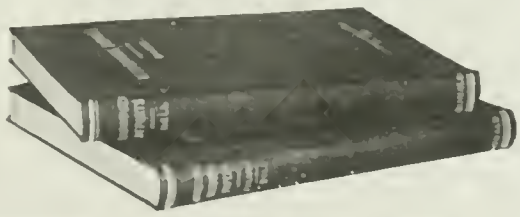

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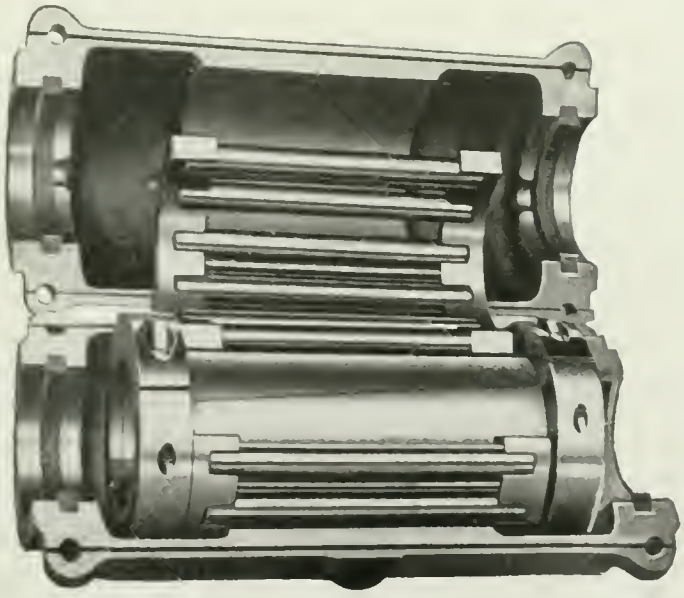

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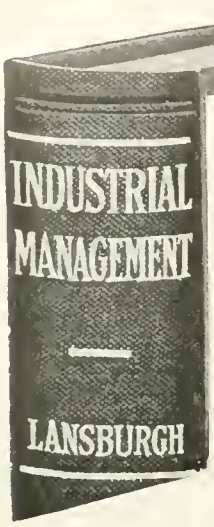

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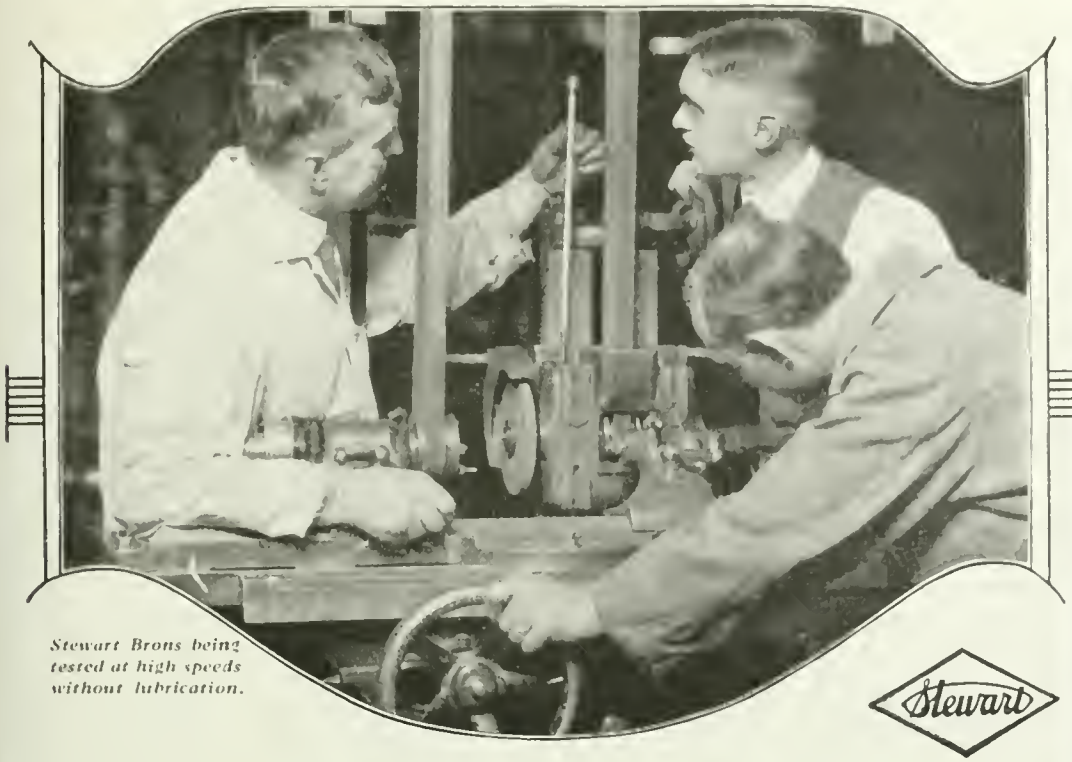

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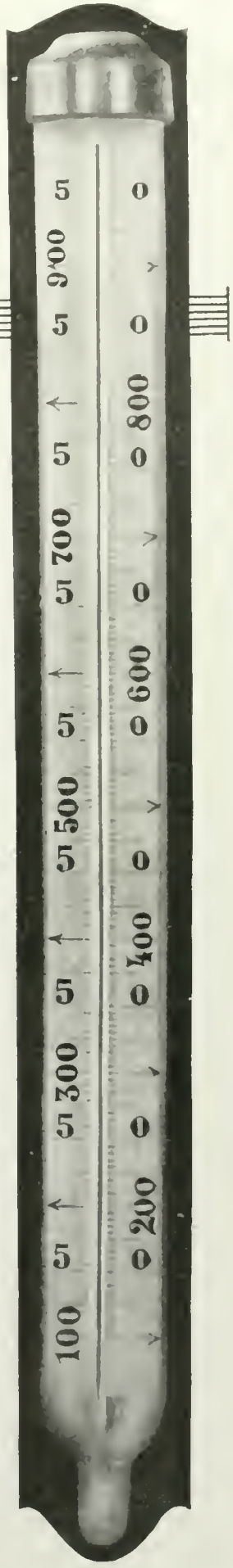

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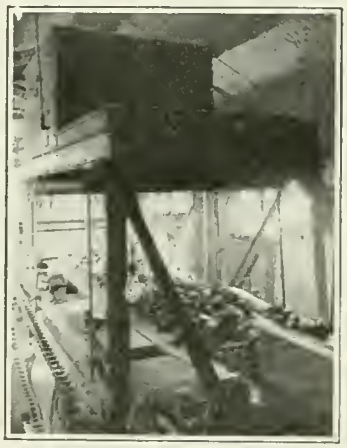

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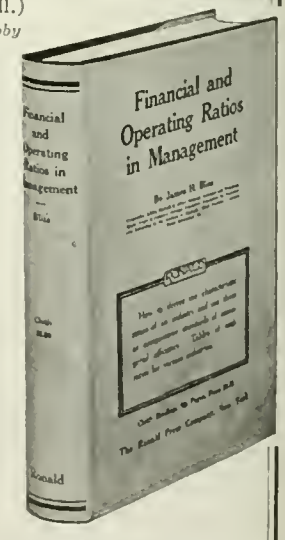

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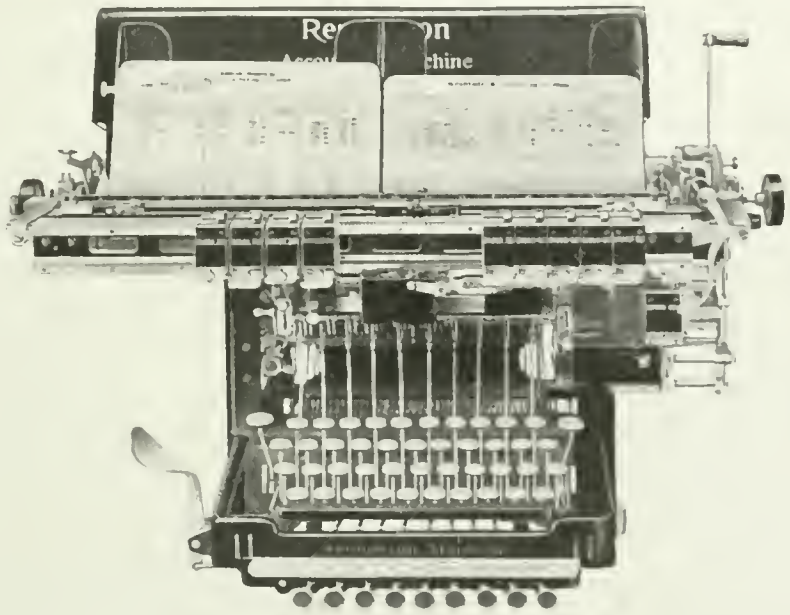

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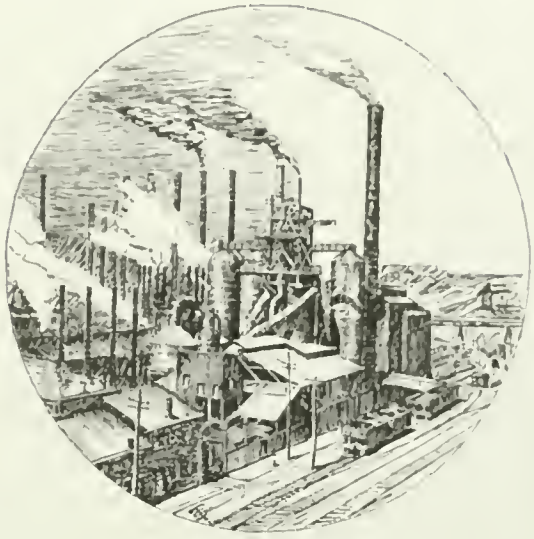

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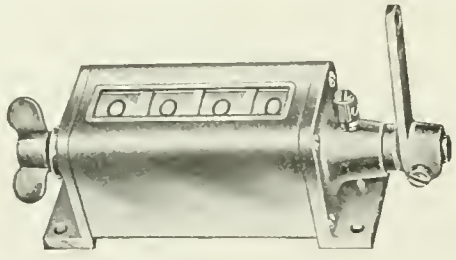

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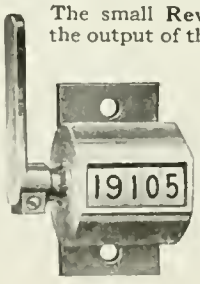

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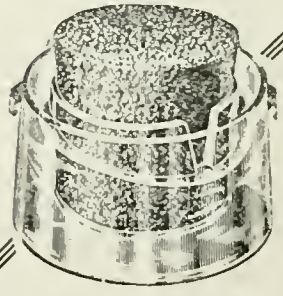

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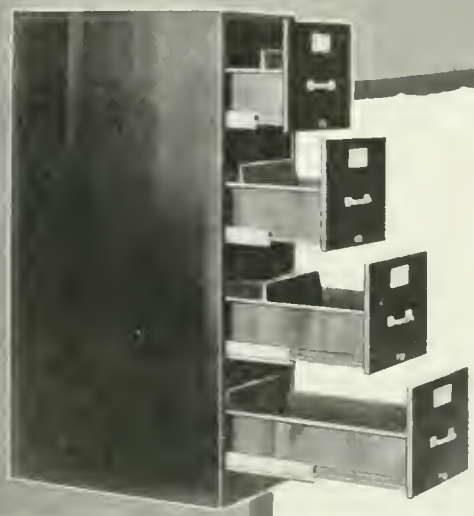

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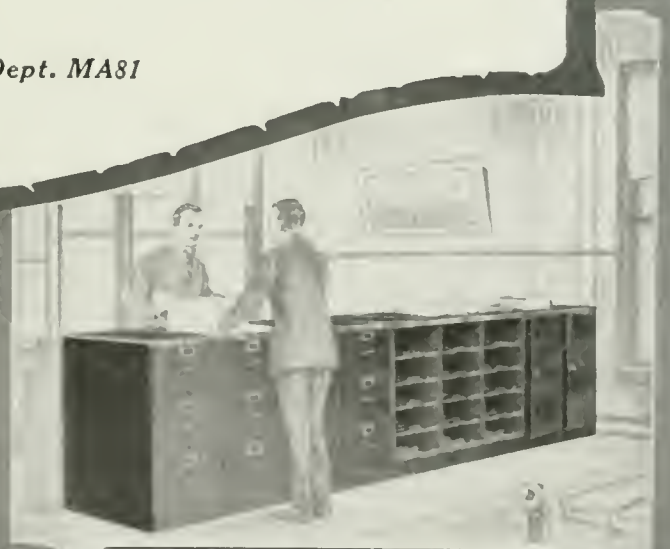

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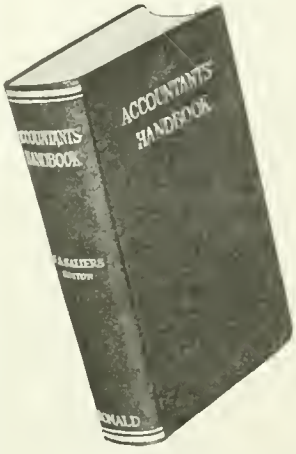

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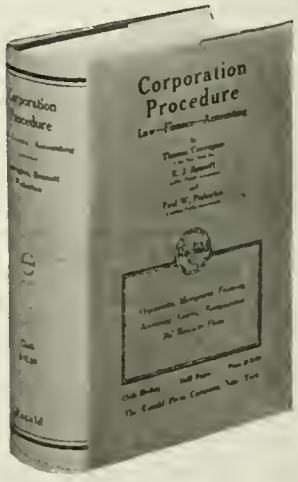

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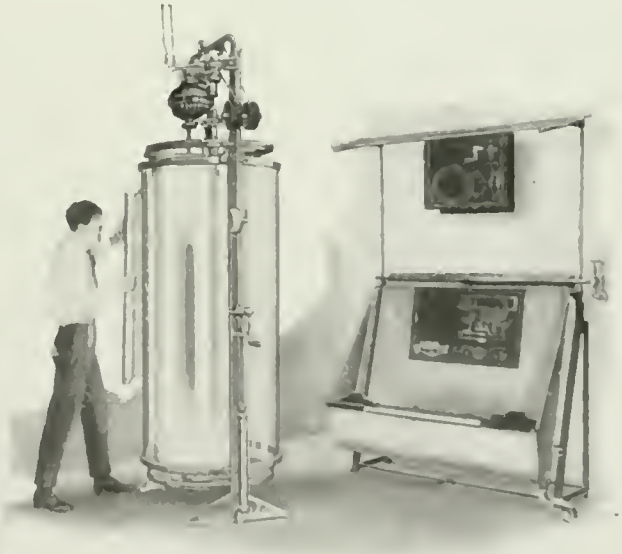

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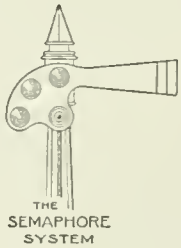

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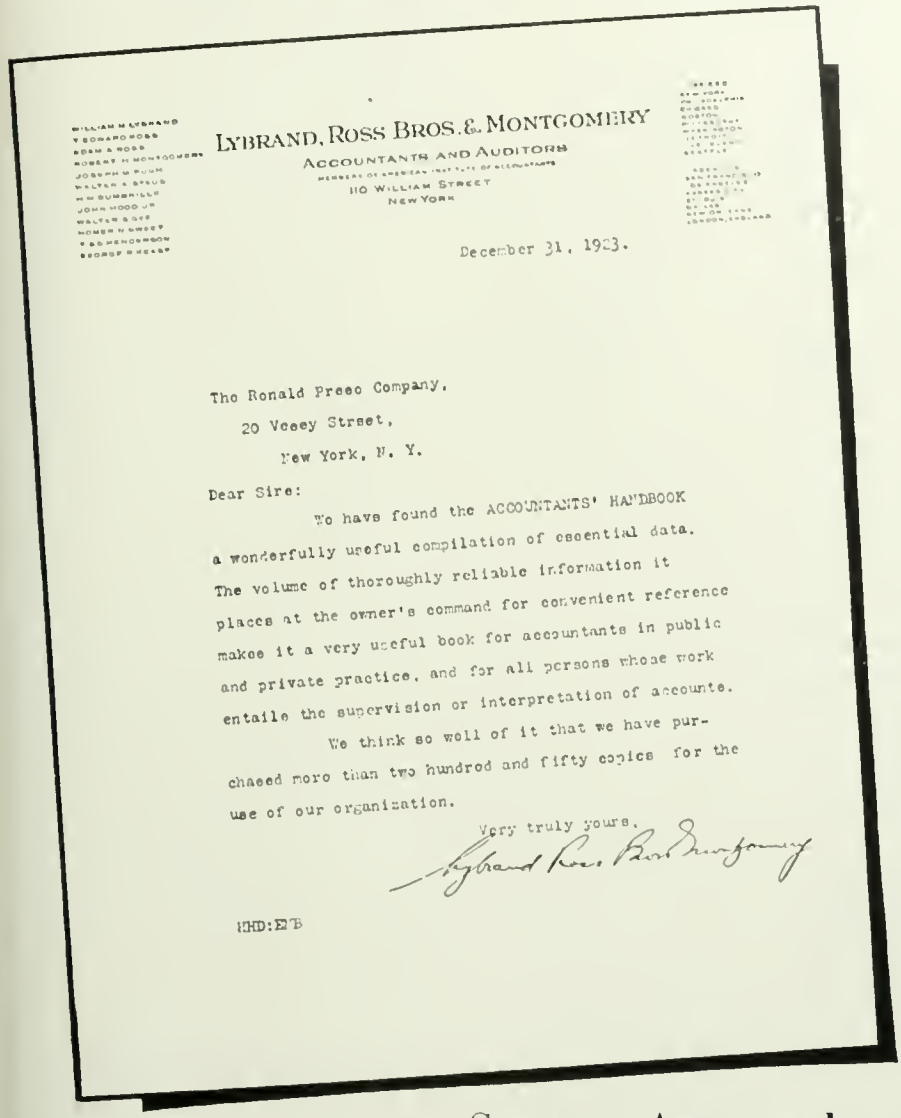

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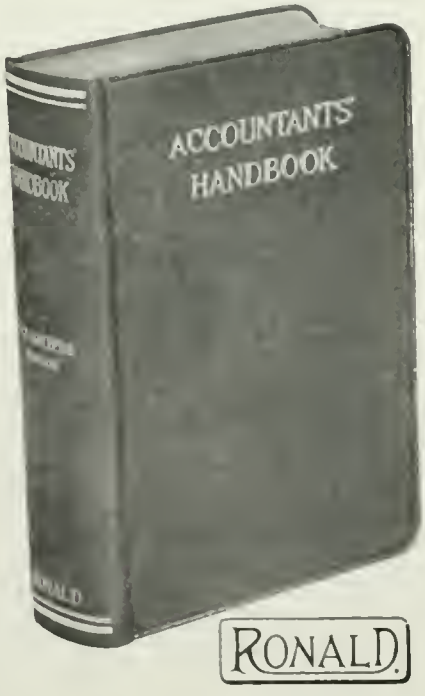

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Vol. VII

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Cover Illustration of Wilson Dam, taken from Tennessee Shore, February 1. Courtesy of Hugh L. Cooper, Engineer.

MANAGEMENT AND ADMINISTRATION is published monthly by the Ronald Press Company: Philip J. Warner, President and Treasurer; William J. Grange, Secretary.

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Authors and Articles in this Issue

"THE Southward Trend of Manufacturing," by **Ralph G. Macy**, is the first of a series of six articles describing the industrial conditions and the surprising industrial development of the Piedmont section of the Carolinas. The author has just returned from an extended trip through this section, undertaken to investigate its industrial status. Mr. Macy is a consulting mechanical and electrical engineer of long and successful experience.

C. S. Mott is Vice-President of General Motors Corporation with headquarters at Detroit. In "Organizing a Great Industrial" he describes in detail the decentralized but closely co-operating organization of General Motors—one of the great industrial organizations of the world. Its well-worked-out organization pictured and explained in this article together with the efficient personnel by which it is manned, accounts completely for the increasingly successful operation of General Motors.

In "Surplus and Its Constructive Application," **J. H. Bliss**, Comptroller of Libby, McNeill & Libby, analyzes surplus according to its source, emphasizing the importance of maintaining a clean-cut distinction between earned surplus and surplus arising from any other source. The article is sixth in the series "Capital Requirements and Control".

"Shop Transportation Economics," by **Stewart M. Lowry**, of the Works Management Department of his Company, is a detailed discussion of the transportation system used in the main works of the Westinghouse Electric and Manufacturing Company at East Pittsburgh, Pennsylvania.

In "Conveyors Require Good Management," **Robert T. Kent**, consulting mechanical engineer, tells how the installation of a conveyor system in the Jackson Mills of Nashua, New Hampshire—described in MANAGEMENT AND ADMINISTRATION for April—brought about a result that entirely overshadows the direct purpose of the installation. The new methods have "reached into the very processes of the mill and compelled the development of every phase of the science of management.

Jerome Mendleson, President of B. T. Babbitt Company, contributes "Controlling the Flow of Package Products by Materials Handling Equipment". Mr. Mendleson has had an extended experience in the lye, lime, and cleanser business. The present company is a combination of the Mendleson Corporation, founded 70 years ago and operating the largest lye works in the country, with the B. T. Babbitt Company, prominent in this same field for almost a century. Since the two firms have been united under Mr. Mendleson, improved methods have more than tripled the annual output.

"Measuring the Savings of Mechanical Handling" is by **W. T. Spivey**, President of W. T. Spivey and Company, material handling engineers. In this article Mr. Spivey explains a method of approaching a material handling problem so as to secure the most suitable equipment at the most favorable price. Applications of the formula worked out by Mr. Spivey are given in the article.

In "Materials Handling Methods That Have Added to Industrial Profits," **George E. Hagemann**, Associate Editor of MANAGEMENT AND ADMINISTRATION, gives data from 55 plants showing the savings effected by the replacement of hand methods or inferior devices with equipment, such as electric and locomotive cranes, hoists, tractors, and conveyors.

Clarence J. Alfred, Supervisor of Production of the American Sugar Refining Company, contributes "Quality Production from the Application of Automatic Handling Equipment". The article describes processes employed by Mr. Alfred's company in the sugar package department, in the filling and sealing of cartons and bags and also in the packing and shipping of cases, sacks, and barrels of sugar.

Geoffrey C. Brown, Chief Engineer, Jacques Kahn, Inc., continues his series on Profitable Methods for the Small Factory with the fourth article, "Wage Incentives and Profit-Sharing". In it he traces the development of wage payments and discusses the advantages and disadvantages of various wage-incentive and profit-sharing schemes.

Frederick C. Mills in "Foreign Trade in Relation to Industry," discusses the economic basis of foreign trade, the trade relations of the United States before, during, and after the Great War, the changing conditions of our foreign trade, and the industrial problems involved in the change. Mr. Mills is associate professor of business statistics, Columbia University. The present article is fourth in the series "Economic Problems of Industrial Organization".

When boilers, reciprocating or turbine steam engines, generators or motors are ordered "they are specified in all detail by the manufacturer". "But it is not so with minor equipment such as piping and insulation," and in "Pipe Specifications and Bills of Material," **Hubert E. Collins**, mechanical engineer, tells "how best to take care of them in specifications". The article is very practical, giving the many details which must be brought into the specifications.

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THE PUBLISHERS' PAGE

Maintaining Schedule for 600 Consecutive Days

Holt Methods of Production Control

ONE of the most striking accomplishments in the record of modern manufacturing is the installation of management methods at the Peoria plant of the Holt Manufacturing Company; methods which have resulted in **scheduled production being absolutely attained for 600 consecutive working days** up to date. There is every reason to believe that this record can be maintained indefinitely, and what makes the accomplishment even more remarkable is the fact that the production schedule has varied, depending upon business requirements. Colonel George D. Babcock, Manufacturing Executive of the company, contributes to our June number the first of five articles describing these methods. The others will follow monthly until all have been published.

SAVINGS made possible by production control are so important and so attractive that the subject warrants careful study and application by every organization. It is not solely a question for production executives, but is of vital interest to those responsible for the interrelated activities of financing and marketing.

The methods devised by Colonel Babcock have given every department of his company a basis for more satisfactory operation. Work-in-process and raw material **inventories** have been reduced. **Financing** has been simplified. **Sales programs** are now made on the basis of a definite knowledge of production possibilities.

COLONEL BABCOCK is one of the best-known and most successful production executives in American Industry. As production engineer of the H. H. Franklin Manufacturing Company, producing the Franklin automobile, prior to the war he placed a rapidly developing business under the Taylor System of Scientific Management. The methods he installed in this plant aroused widespread interest and attracted hundreds of visiting executives to study the possibility of applying similar methods in their own organizations.

Upon America's entry into the war, Colonel Babcock joined the forces of the Ordnance Department in France and served with distinction until the close of the war. Returning to America he joined the staff of the Holt Manufacturing Company as Manufacturing Executive.

The **installation of management methods** at the Holt plant presented many special difficulties. Conditions in the tractor industry following the war boom were chaotic. Production at any cost had to give way to production for competitive markets. Labor was drawn from the farms—there was no reserve of skilled mechanics from which new working forces might be recruited. Scientific management had been attempted in the Rock Island Arsenal in the same general district and had failed because of the opposition it had aroused among the workers.

The **group of five articles** will show in detail how each problem that arose in installing scientific management was met. The methods that have made possible the outstanding accomplishment at the Holt Plant will be outlined for practical use. We recommend these articles to the attention of all our readers in the belief that the methods used by Colonel Babcock offer golden possibilities for profitable adaptation in every plant and factory without respect to product.

General Electric Type I-6 Sprague Hoist with standard push button control, lifting heavy gear case at A. B. See Electric Elevator Company, Jersey City, N. J. This hoist is equipped throughout with Hyatt roller bearings.

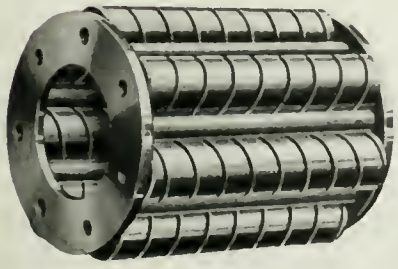
General Electric Company Standardizes on Hyatt Bearings For Its I-6 Sprague Hoists

The General Electric Company, anticipating the sort of exacting service required by the A. B. See Electric Elevator Company, equips these heavy duty hoists with Hyatt roller bearings throughout.

A designer of hoisting equipment has stated that it takes at least a minute for a plain bearing hoist to reach its full efficiency due to the time required to form a film of oil over the bearing surfaces. Since the average time of operation is only 1/7 to 1/4 of a minute, plain bearing hoists can rarely function effectively.

Hyatt bearings, due to their true rolling motion and self-contained lubrication, have a starting friction practically as low as their running friction. In hoists this means smooth operation and easy handling. This feature together with automatic push button control permits accurate spotting of work with the I-6 Sprague Hoist.

To insure satisfactory performance specify Hyatt equipped cranes, trolleys and hoists for *your* plant.



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CONDITIONS AND PROSPECTS IN BUSINESS AND INDUSTRY

PREPARED BY LEWIS H. HANEY

Director, New York University Bureau of Business Research [1]

Barometer of Industry and Trade

Moderate Business Recession at Hand

Business has been developing along lines forecast last month and the reader is referred to the April issue of MANAGEMENT AND ADMINISTRATION for a fuller discussion of the underlying reasons for the present recession. Briefly the facts are that production in most basic industries has continued to increase, while at the same time the general price level has decreased. *The immediate prospect is for further reduction in buying activity* with the beginning of a general tendency toward curtailment of production resulting. The probability now is that there will be an early readjustment between demand and supply on a somewhat lower basis than that which existed last spring.

The P V line, which has thus far infallibly forecast business conditions by about 5 months, continued its downward course during March; and it is, therefore, predicted that no general recovery is in prospect during the next 4 to 6 months. The failure bars shown in Fig. 1, by their greater length indicate the effects of recession on business prosperity; the decline in the interest rate curve indicates the relative weakness of demand for funds which has come with the checking of business expansion.

By May the general business recession will be clearly apparent. Already there has come the turn in retail trade, which, taken together with the checking of the rate of increase in production, is all that is needed to complete the picture.

That the anticipated recession in business will not be violent was forecast in the April issue, and that forecast is here renewed. The recession which lies ahead is not one to cause alarm or panic. In the first place, there has been ample and early warning of the failure of the upturn at the end of 1923 to carry through. Business men are everywhere advised of the situation from numerous public and private sources. In the second place, the spirit of caution—not to say pessimism—which has existed for some time, is a guarantee that no sudden shock is to be expected. It has been many years since there has been so general and pronounced pessimism among the rank and file of small traders and small business men as at present.

[1] Assisted by Horace J. Barney, Harry Comer, and Stephen DuBrul of the Bureau's Staff.

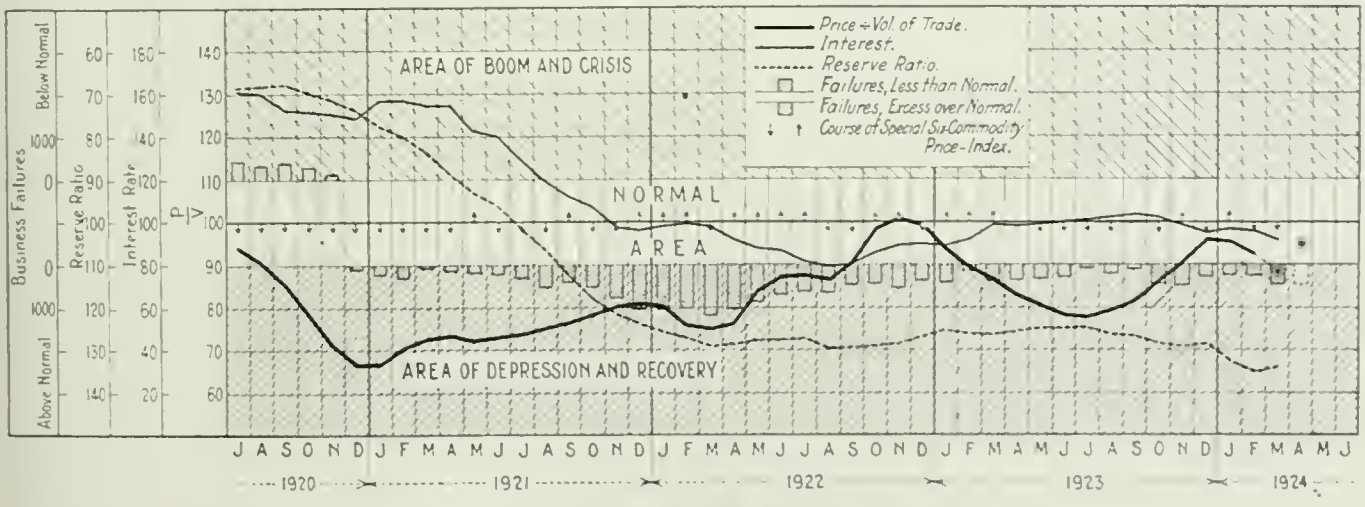

Price÷Vol. of Trade.
Interest.
Reserve Ratio.
Failures, Less than Normal.
Failures, Excess over Normal.
Course of Special Six-Commodity Price-Index.
AREA OF BOOM AND CRISIS
NORMAL AREA
AREA OF DEPRESSION AND RECOVERY
Business Failures
Below Normal
Above Normal
Reserve Ratio
Interest Rate
P V
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1920
1921
1922
1923
1924

FIG. 1 THE BAROMETER OF INDUSTRY AND TRADE

The P V line (drawn heavy) is the business forecast line. It shows the trend of commodity demand, and is the ratio between Bradstreet's index of wholesale prices and the physical volume of trade (carloadings times tons per car), based on 1912 as the normal year. It is plotted as a three months' moving average, centered successively on the middle months, except that the final dotted portion of the line runs to the actual figure for the last month. A rise in the curve indicates increasing demand, and vice versa. The interest rate curve has been corrected for seasonal variation, and index number 100 equals 5 per cent. The federal reserve ratio of cash reserves to note and deposit liabilities is inverted to harmonize its indications with the rest of the curves, and is corrected for seasonal variation. Business failure bars are based on Dun's reports, and normal is taken as the trend for 40 years. The six-commodity price index is based on special investigation by the N. Y. U. Bureau. April 1924 data shown are probable trends. Areas in which curves lie indicate that business is good, normal, or poor.

In the third place, there has been a very prompt curtailment in many over-extended lines. This is obvious in the cotton textile industry. Apparently production in the copper industry has been checked. The average daily production of pig iron, while it increased during March, did so at a very much lower rate. The tonnage of traffic originating on the railways has been steadily declining for at least three weeks down to the middle of April and has fallen below the 1923 level. This is one of the most hopeful indications in the existing situation since it insures a speedy readjustment of output to market conditions.

There have been no great speculative excesses, although in the automobile and building industries it may be that there has been some undue activity by individual companies and in certain localities. There has been no credit inflation such as to result in inflated prices and high money rates. Consequently, no severe reaction is probable.

In this connection it may be noted that production on the whole is as yet but little above a normal level. It is high, but could not be called excessive if there were less uncertainty and political disturbance.

Prices, too, are still 12 per cent higher than the average of 1921 and, as will be noted, the rate of decline has been checked.

It, therefore, seems likely that a condition of at least temporary equilibrium will be found within a period of 3 or 4 months and that the level will then not be greatly lower than that of early 1923.

Recent Developments. The outstanding developments in the business and industrial situation during the period from March 1 to April 15 were as follows:

1. Retail trade began to decline and postal receipts fell off.
2. The indicated trend of building activity became downward during March.
3. Unfilled steel orders declined.
4. Business failures have increased in number.
5. Exports and imports have been decreased, and the so-called "favorable" balance of trade has narrowed.
6. Wages held firm or increased during March, while the trend of cost of living was down.
7. The rate of increase in production in basic industries has been checked and railway tonnage has been declining.
8. The downward trend of prices has been checked, with some appearance of approaching stability.

Favorable and Unfavorable Factors. The conditions which look favorable and those which look unfavorable at the middle of April are as follows:

FAVORABLE FACTORS

1. The early checking of overproduction in many lines.
2. Greater stability in prices.
3. Continued high purchasing power of consumers.
4. Lower cost of living.
5. The improved European outlook.
6. Prevalence of caution.

The real progress being made under the leadership of the Dawes report should be noted. With England, France, and Germany all agreeing to the principles of the report and with the foreign exchange rates rising, it seems more than ever probable that we are witnessing the *beginning* of a final European settlement. Such a settlement, while it would bring numerous readjustments some of which would be unfavorable to American manufacturers, would help our raw material and foodstuffs industries, and would eventually be constructive.

UNFAVORABLE FACTORS

1. Declining prices. (Fig. 11).
2. Increased business failures. (Fig. 12).
3. Building outlook unfavorable, with contemplated construction down, and contracts awarded up less than usual for the season. (Fig. 6).
4. Outlook not favorable for automobile manufacturers.
5. Retail trade declines. (Fig. 10).
6. Unfilled steel orders decrease. (Fig. 3).
7. Decreased employment. (Fig. 15).
8. Decreased exports and imports. (Fig. 7).
9. Increased stocks of commodities in many industries. (Table 1).
10. Post office receipts down with bank debits about to follow. (Fig. 9).

FUTURE DANGERS

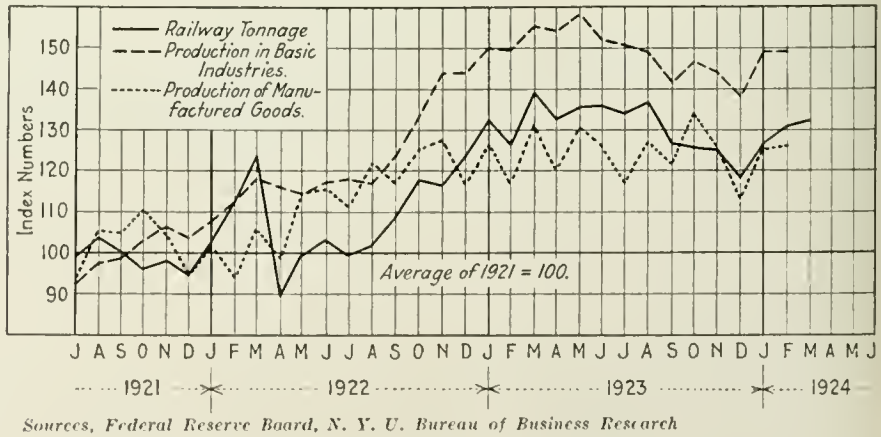
1. Early termination of building boom.
2. Strained credit due to sales "on time".
3. Increased competition from Europe.
4. Wages too high and necessity of reducing costs to meet European competition.
5. Withdrawal of European capital as result of improvement there.
6. Possibility of third party developments leading to agitation for government ownership, etc.
7. Inflation based on borrowing for soldiers' bonus, farm relief, etc.

The increased possibility of inflation should be noted. The chances now favor a soldiers' bonus measure and the talk is of increased appropriations; at the same time taxes are to be reduced, the idea being that the government should have its cake and eat it too. This means a step in the direction of an unbalanced budget and inflation. The increased difficulty in making cash sales is leading to selling "on time" a wide list of things, ranging from securities to radios. This tends to inflated credit. The desire of politicians to keep business good is a factor which may tend to let down the credit bars. The pressure from distressed borrowers will support the politicians in any such move; and at present borrowers are extremely numerous.

Production and Stocks of Commodities

Production Rise Less Rapid: Stocks Increase Somewhat

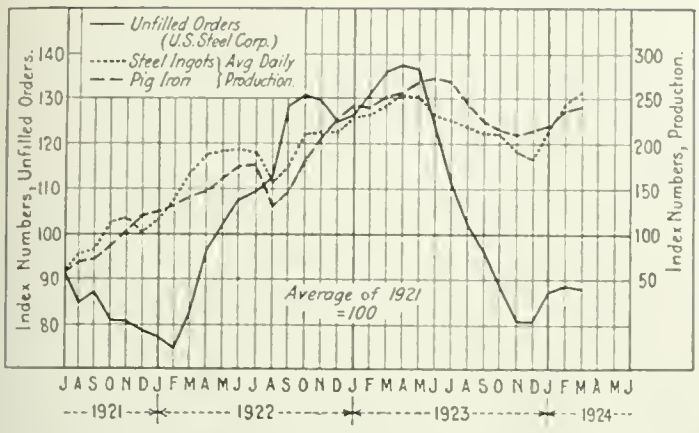
Zinc stocks decreased 14.5 per cent during March, probably reflecting the great activity in the steel industry. Newsprint paper stocks increased 6.5 per cent, not a favorable indication for that industry. Automobile tire stocks



Sources, Federal Reserve Board, N. Y. U. Bureau of Business Research

FIG. 2 RAILWAY TONNAGE AND PRODUCTION IN INDUSTRY

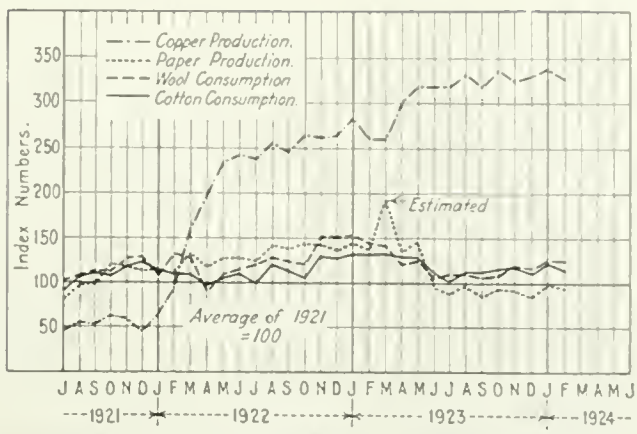
Railway tonnage and production in basic industries corrected for seasonal variation. Production in basic industries also corrected for normal growth.


Unfilled Orders (U.S. Steel Corp.)
Steel Ingots } Avg Daily
Pig Iron } Production
Index Numbers, Unfilled Orders.
Index Numbers, Production.
Average of 1921 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921 1922 1923 1924

Sources, Iron Age, American Iron and Steel Institute

FIG. 3 IRON AND STEEL PRODUCTION AND UNFILLED ORDERS

Data for all curves have been corrected for seasonal variation.


Copper Production.
Paper Production.
Wool Consumption
Cotton Consumption.
Index Numbers.
Estimated
Average of 1921 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921 1922 1923 1924

Sources, American Bureau of Metal Statistics; American Paper and Pulp Association; Bureau of Census; Dep't of Commerce

FIG. 4 PRODUCTION IN FOUR IMPORTANT INDUSTRIES

Cotton and wool corrected for seasonal variation.

rose 8.5 per cent, an unfavorable development. Gasoline stocks, after allowing for the seasonal factor, remain practically unchanged. The stocks of merchant pig iron declined 4 per cent; but, this figure may rise during March.

Production and Railway Tonnage

Railway Tonnage. As shown in Fig. 2, the tonnage of freight originating on the railways increased in March, but the following facts should be noted:

1. The figure was 5.7 per cent lower than last year.
2. The rate of increase was much smaller than in the two preceding months.
3. In the last few weeks of March the tonnage was decreasing.

The adjusted index of tonnage gives a true picture of physical volume of trade, and the figures are as follows: March 1923, 139.2; January 1924, 127; February 1924, 130.8; March 1924, 132.5.

Production. Production in basic industries during February was unchanged from January; the index number being 149. Probably there will be a decrease in March.

The output of manufacturing industries as a whole showed a small increase in February and was higher than a year ago. This gain will have to be checked.

Conclusion. The checking of the rate of production in basic industries is a good sign. It should mark the turn and mean an early readjustment in production. Probably railway tonnage will decrease in April.

TABLE 1. STOCKS OF IMPORTANT COMMODITIES ON THE FIRST OF THE MONTH

Average for 1921 = 100. Gasoline, raw sugar and cottonseed oil adjusted for seasonal variation.

Month and Year	Gasoline	Leather (Cattle)	Zinc	Newsprint Paper	Automobile Tires	Raw Sugar	Cotton-Seed Oil	Merchant Pig Iron	Dept. of Com. Index of Stocks—45 Commodities
	100 = 630,757,000 gals.	100 = 19,742,000 pieces	100 = 77,202 tons	100 = 30,009 tons	100 = 4,364,000 tires	100 = 114,000 tons	100 = 255,400,000 lbs.	100 = 634,950 tons	100 = 132
July 1921	103	100.5	116.4	88.7	95.2	109.0	118.5	109.5	93.0
Aug.	109	99.5	119.7	85.0	89.2	77.0	123.0	109.5	89.5
Sept.	108	99.5	112.1	90.4	90.2	87.0	129.5	100.0	92.0
Oct.	109	96.4	105.1	100.8	76.6	116.0	60.0	94.0	103.0
Nov.	102	95.9	91.7	76.7	81.2	69.0	71.0	82.0	100.0
Dec.	102	95.2	86.8	77.1	89.6	96.0	84.0	80.0	104.0
Jan. 1922	103	98.5	78.5	79.8	84.7	95.0	92.0	86.0	104.0
Feb.	110	99.0	85.1	88.5	95.6	88.0	84.0	90.5	113.0
Mar.	110	100.7	83.1	92.7	107.5	136.0	82.0	86.0	114.5
Apr.	110	95.4	78.1	93.9	118.8	186.0	84.0	84.5	104.0
May	110	101.5	67.0	82.9	125.2	140.0	89.0	70.0	94.0
June	111	101.6	52.3	82.6	126.6	105.0	82.0	52.5	95.5
July	114	98.3	38.3	77.9	115.5	107.0	84.0	40.0	88.0
Aug.	123	97.4	37.1	70.5	110.8	151.0	87.5	38.0	76.5
Sept.	133	91.5	28.0	66.3	106.1	132.0	89.0	25.0	84.0
Oct.	146	90.2	24.4	62.7	105.7	122.0	37.0	23.8	97.0
Nov.	161	87.7	23.4	65.8	107.3	70.0	35.0	25.0	92.0
Dec.	160	85.9	25.3	65.4	113.8	55.0	42.0	29.8	95.0
Jan. 1923	156	85.3	23.6	64.0	105.4	55.0	52.0	35.8	95.5
Feb.	156	84.0	21.5	76.7	107.6	76.0	60.0	43.0	98.5
Mar.	154	82.6	14.1	77.3	119.7	86.0	64.5	44.0	100.0
Apr.	162	81.6	13.0	67.2	129.9	168.0	67.0	38.0	93.0
May	164	81.4	11.6	62.0	139.3	147.0	69.0	41.7	79.0
June	173	82.1	16.9	60.5	159.6	97.0	71.0	53.6	78.0
July	174	82.8	22.2	65.0	161.4	97.0	76.0	72.7	77.5
Aug.	185	83.6	27.5	74.0	148.0	96.2	74.0	97.5	79.5
Sept.	199	84.3	34.4	85.5	138.5	81.8	57.4	111.0	86.5
Oct.	206	84.2	29.6	82.2	123.2	130.4	28.0	121.7	96.0
Nov	211	85.4	33.4	82.4	111.7	102.8	43.0	131.0	100.0
Dec.	202	85.8	40.3	80.0	107.5	89.8	43.3	141.0	102.0
Jan. 1924	186	87.0	47.3	78.8	99.0	79.0	52.5	145.0	100.0
Feb.	187.5	79.5	52.7	94.6	111.0	54.5	53.5	144.5	100.0
Mar.	188	83.8	48.0	101.0	120.5	90.0	58.5	140.0	
Apr.			41.5						

Iron and Steel Production

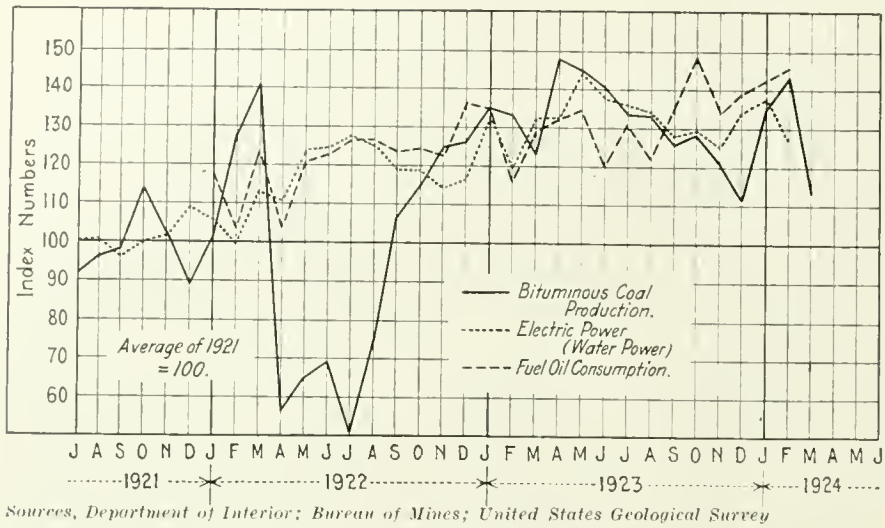
Production. During March the average daily pig iron production rose 1 per cent above the previous month's level. The index, which for March was 238.5, is now 240.5. This is a very much smaller increase than during February when the index rose 9 per cent. The average daily production of steel ingots, however, reached a new high level. The index is now 257 as compared with 244 for February—a rise of 5 per cent. (Fig. 3).

Unfilled Orders. Unfilled orders of the United States Steel Corporation were 4,783,000 tons on April 1, a decrease of 2.5 per cent, but the index on March 1, when corrected for seasonal variation, was 88.5, and on April 1 was 88, a decline of only about 0.5 of 1 per cent. However this reversal in direction of movement probably marks the beginning of a decline in this index which may continue for the next few months.

Unfilled orders for 108 merchant pig iron furnaces as of March 1 were 1,242,000 tons, a decline of 0.5 of 1 per cent.

Prices. The Iron Age composite steel price on March 11 was 2.746 cents per lb., and on April 15, 2.703 cents per lb. The composite pig iron price was $22.86 per ton on March 11, and $22.50 on April 15.

Conclusion. The iron and steel industries increased output much more than the gain in orders during last November and December warranted, and as a result the market for their products has



Sources, Department of Interior; Bureau of Mines; United States Geological Survey

FIG. 5 FUEL AND POWER PRODUCTION

Bituminous coal and electric power corrected for seasonal variation.

weakened. There is no prospect of a serious price decline in either the steel or iron market, but the price will undoubtedly yield to pressure of stocks.

Production in Important Industries

Copper. Production of copper during February declined 3.5 per cent, but this decline is practically all due to the short length of that month, and reflects no change for the better in this industry. At present, with the European outlook improving, there is some hope that the demand for copper will rise. (Fig. 4).

Paper. The index of paper production declined 4 per cent during February, all of which is seasonal in character, and as a result shows no tendency to curtailment of output. But the outlook for the paper industry continues somewhat more favorable than for many others.

Wool. During February wool consumption decreased, after allowing for the usual seasonal trend. The index fell from 128 in January to 126.5 in February, or 1 per cent. The woolen industry seems to be very steady, showing no inclination to any change either in output or price. It is the strongest among the textiles.

Cotton. The index of cotton consumption during March decreased 13.5 per cent from the February level after allowing for the normal seasonal factor. The actual decrease was 5 per cent. Restricted production is resulting from the continued resistance to any price increase of the finished product sufficient to cover the increased expenses resulting from high raw material cost. The cost of raw cotton has been somewhat reduced and this should tend to improve the situation in cotton textiles.

Fuel and Power

Coal. The index of bituminous coal production declined 21 per cent during March. (Fig. 5). The index on March 31 was 143.5 and on April 30, 113.5. Stocks of coal are large and the curtailment of production has been forced by the low prices from overproduction.

Fuel Oil. The rate of fuel oil consumption rose 2.5 per cent during February. The index (Fig. 5) rose from 142.5 for January to 146 for February. Fuel oil prices continue strong.

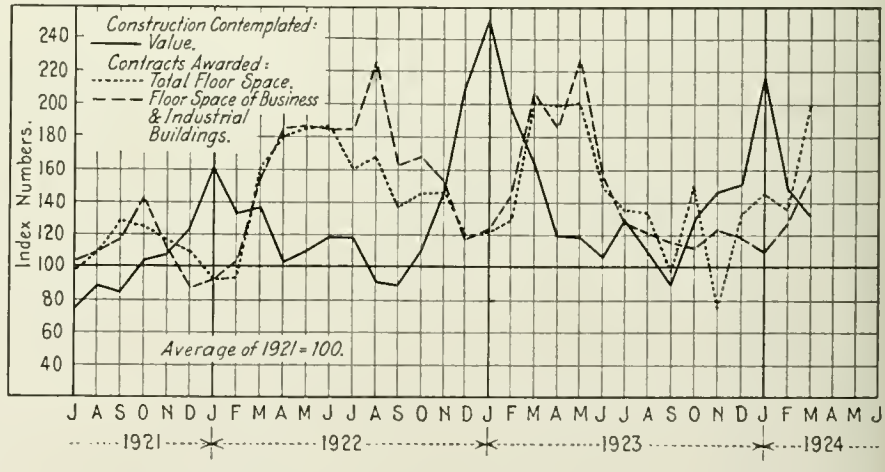
Hydroelectric Power. The index of hydroelectric power production declined sharply during February, after eliminating the usual seasonal change. The January index was 137.5 and that for February 127, 7.5 per cent lower, and still further declines are expected during the next few months.

Building Activity in February

Contemplated Construction. According to F. W. Dodge Company, contemplated construction in 37 states declined 11 per cent during March, and is now 17.5 per cent below the level of March, 1923. (Fig. 6).

Contracts Awarded. The index of the total floor space for contracts awarded rose during March. The index which was 135.2 for February was 200 for March, a rise of 48 per cent. This gain, however, appears to be entirely seasonal in character and does not indicate any increase in the annual rate of construction. The floor space in total contracts awarded in March was the same as a year ago. The index of business and industrial building also rose, gaining from 127.3 for February to 158 for March, but is lower than March 1923.

Conclusion. The continued decline in contemplated construction supports the contention that there will be no building boom this year similar to that of last year. This offers less hope for a heavy demand for iron and steel. Much of the work being done is in New York, (where speculative residential construction has been active), and therefore the general situation is not so good as might appear from the above data.



Source, F. W. Dodge Company

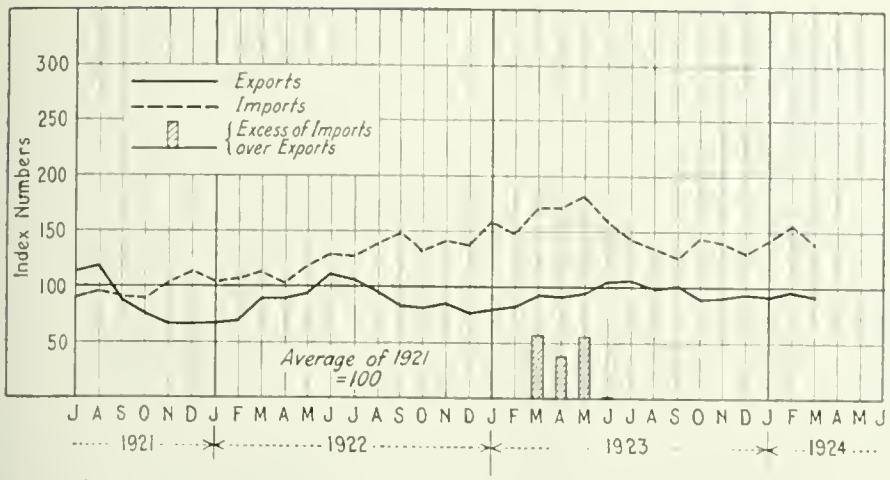
FIG. 6 BUILDING CONSTRUCTION AND FLOOR SPACE IN CONTRACTS AWARDED

Construction contemplated corrected for seasonal variation.

Trend of Trade and Finance

Downward Price Trend Moderates: Trade Passes Peak

Imports during March totaled $319,000,000, a decline of 5 per cent from the February figure. The average experience in the past has been that March imports exceed those of February by about 14 per cent. Hence the adjusted index shows a greater decline than that revealed by the actual imports figure in dollars. The March adjusted index is 137.5, against 163.1 for February, a loss



Source, U. S. Department of Commerce

FIG. 7 FOREIGN TRADE OF THE UNITED STATES

All data have been corrected for seasonal variation.

of 16 per cent for the month. (Fig. 7).

Exports during March amounted to $341,000,000, the smallest since last August, and a decline of about 7 per cent from the February total. This decline is largely seasonal. Adjustment for seasonal variation gives a March index of 93.1, compared with 95.2 for February.

Conclusion. The March foreign trade figures show a tendency to confirm our predictions of last month. Merchandise imports are now running very close to exports. An import surplus in the not distant future seems probable. Our total balance of trade (including foreign travel, ocean freights, etc.) is undoubtedly "unfavorable" at the present time.

New York Stock Exchange

As shown in Fig. 8, there has been a fairly steady decline in prices of stocks in the New York Exchange since the middle of March. The weekly average of 50 stocks was down from 86.13 to 84.03 in the week ended April 12. Stocks have reached a new low level since the week ended December 29, 1923.

During the period covered, the volume of trading averaged around 800,000 shares a day, with a tendency to decrease on price advances, which is a symptom of weakness. At the middle of April, however, there were evidences that the market was oversold, with a technical rally due.

But it is plain that the stock market is discounting the less favorable outlook for business. It is not likely that there will be any sustained advance in the stock market until the end of the recession in business is in sight.

Bank Debits and Postal Receipts

Bank Debits. The March adjusted index of average weekly debits to individual accounts is 128.7 as compared with 122.7 for February. The March position of the index is higher than for any other month in the period covered by our chart (Fig. 9). A decline is now probable.

Postal Receipts. The unadjusted index of postal receipts for 50 selected cities gained about 8 per cent. This gain, however, was considerably less than the normal seasonal gain during March. As a result, the adjusted index shows a decline from 123.4 for February to 120.3 for March.

Conclusion. Bank debits indicate a large volume of trade. Postal receipts, on the other hand, point to a slackening tendency. *It is anticipated that the volume of business will decline during the next few months.*

Retail Trade

Mail Order Sales. March sales of the two leading mail order concerns totaled $31,450,000, as compared with $30,467,000 in February. (See Fig. 10). The adjusted index for March was 135.2, against 149.5 for February.

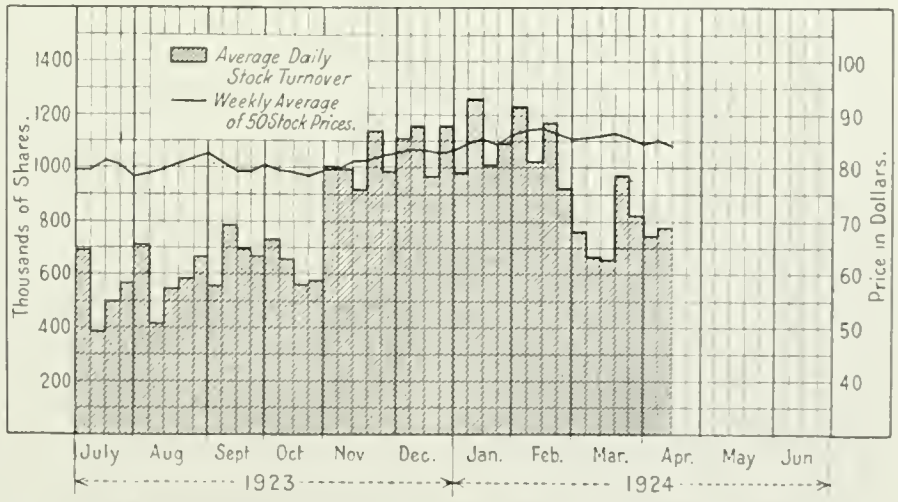
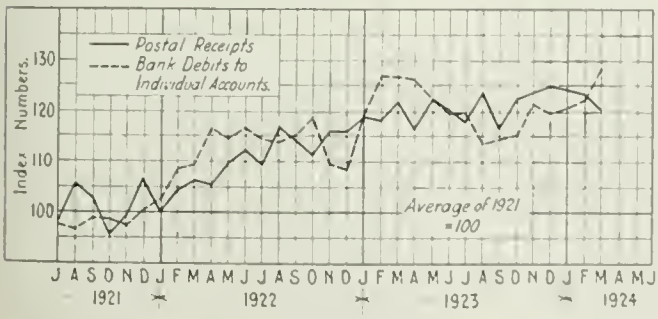


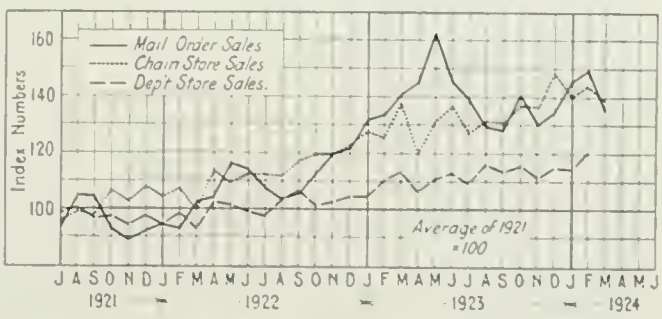
FIG. 8 STOCK TURNOVER AND PRICES ON NEW YORK STOCK EXCHANGE


Postal Receipts
Bank Debits to Individual Accounts.
Index Numbers.
130
120
110
100
Average of 1921 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Federal Reserve Board; Post Office Dep't.

FIG. 9 BANK DEBITS AND POSTAL RECEIPTS

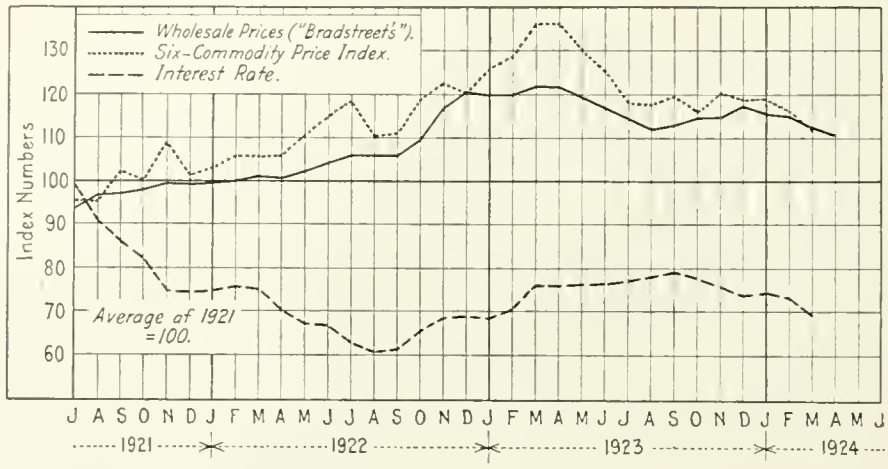
The data for both curves have been corrected for seasonal variation.


Mail Order Sales
Chain Store Sales
Dept Store Sales.
Index Numbers
160
140
120
100
Average of 1921 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Commercial and Financial Chronicle; Federal Reserve Board

FIG. 10 SALES OF MAIL ORDER, CHAIN AND DEPARTMENT STORES

The data given cover 2 mail order houses, 4 chain stores, and 306 department stores, and are corrected for seasonal variation.



Sources, Commercial and Financial Chronicle; Federal Reserve Board

FIG. 11 WHOLESALE PRICES AND INTEREST RATE

Interest rate is the monthly average, corrected for seasonal variation.

Chain Store Sales. The adjusted index of the March sales of four large chain store systems showed a decline of about 3.5 per cent from the February index, but this is not serious.

Department Store Sales. After allowance for the average monthly change in the past, the February index of department store sales—the latest available—stands at 120.5, as compared with 114.3 in January, a gain of 5 per cent.

off sharply in March, all six commodities being down except copper. This index registered 111.5 against 116.3 in February. It also reached the lowest level since September 1922.

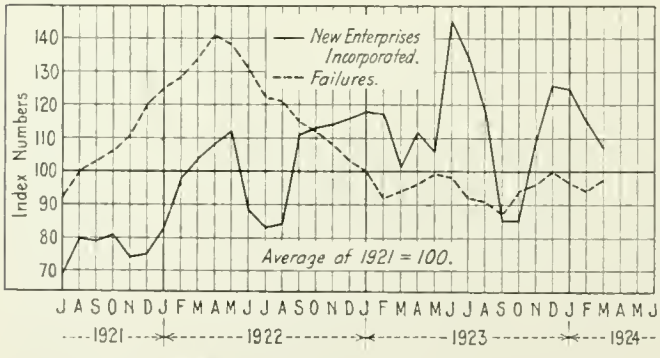
Interest Rate. The interest rate on highest grade commercial paper registered a notable decline in March, falling from 4.75 to 4.56 per cent on the New York market. The index number, based on the average of 1921 as 100, declined

As usual a period of falling prices is followed by a declining money rate. The great abundance of funds and the less favorable outlook for profits in business indicate that money rates will continue relatively low for some time. The chief factor working for firmer money is the large amount of security issues which is awaiting flotation. Demand for investment in European securities will probably increase before long.

New Enterprises and Business Failures

New Enterprises. New business enterprises as measured by their capitalization increased in March and the monthly adjusted index also advanced. (See Fig. 12). The 3 months' average shown in the graph, however, decreased for the third consecutive month. This decline in the 3 months' moving average probably indicates the true trend.

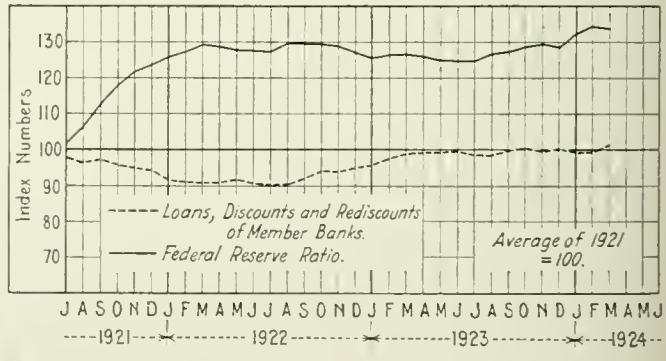
Business Failures. The number of business failures has been steadily increasing in comparison with normal. (See Fig. 12). The monthly index during March increased from 95.9 to 105.6, thus bringing the figure over the average for 1921. The 3-month average plotted in the graph also increased.



Sources, Dun's Review; N. Y. Journal of Commerce

FIG. 12 BUSINESS FAILURES AND NEW ENTERPRISES

Both curves adjusted for seasonal variation. Values plotted are the 3 months' moving average.



Source, Federal Reserve Board

FIG. 13 BANK CREDIT AND FEDERAL RESERVE RATIO

Federal reserve ratio is ratio of total reserves to note and deposit liabilities and has been corrected for seasonal variation.

Conclusion. It is believed that the volume of retail trade, while at present large, is now turning the corner and will recede further in the next few months.

Prices and Interest Rate

Prices. The curves shown in Fig. 11 indicate the decided drop in commodity prices which was one of the outstanding features of March, and which was forecast by the downward trend of the P/V line in January and February. Bradstreet's index of wholesale prices (on the basis of 1921 as 100) stood at 112.4 on April 1. The index number was 114.6 on March 1.

The special six-commodity index fell from 73.3 in February to 69.5 in March. This index is adjusted for seasonal variation. At the end of March and early in April there was some slight evidence of a firmer money market.

Conclusion. The heavy production in basic industries coupled with excess capacity therein has tended to bring about a condition of overproduction. Uncertainty as to the future, with the attendant hand-to-mouth buying which is so prevalent, has tended to keep demand at a minimum. It is natural, therefore, that prices should have declined.

The outlook is for some further sagging in commodity prices, but at the middle of April it appeared that the general decline had been checked.

Conclusion. Accordingly, it may be said that the trend of business failures is at present upward while the trend of new enterprises is downward, which is an unfavorable symptom of conditions. The increase in the number of business failures reflects the narrower profits and declining volume of business in many lines. Such an increase as has taken place during the last two months, and which is now reflected in the 3 months' moving average, makes impossible a favorable forecast for the near future.

Bank Credit

Loans and Discounts. Total loans and discounts of the 756 reporting member

banks of the federal reserve system were $12,065,055,000 on March 26. This is the highest figure since March 1921. The index for March stands at 101.2, compared with 99.6 for February. (See Fig. 13).

Federal Reserve Ratio. After eliminating normal month-to-month variation, the March index of the ratio of reserves to deposit and federal reserve note liabilities combined, declined to 133.9 from the February position of 134.7. This change was due to a combination of shrinkage in gold holdings and enlargement of deposits.

Conclusion. The March changes in these two indexes are insignificant. The gain of about 1.5 per cent in loans and discounts may be partly seasonal, as no adjustment is made in the indexes for that series. A continuation of abundant credit is indicated.

Wage and Employment Situation

Slight Fall in Employment: Earnings Hold Up

Earnings and Cost of Living

The course of average weekly earnings and the cost of living is shown in Fig. 14.

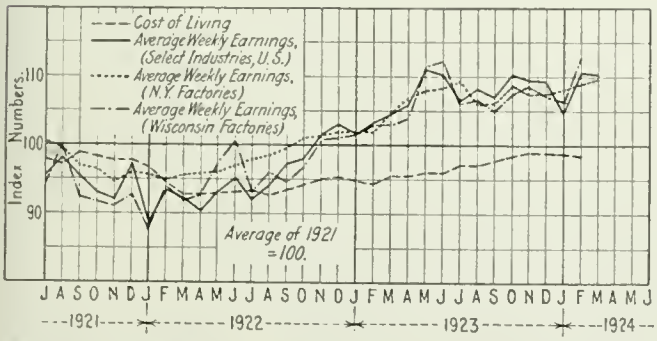
New York State. For the fourth consecutive month the seasonally corrected index of earnings has increased slightly. In March this index stood 9.5 per cent higher than the average for 1921 and 4.5 per cent above that for March 1923. Actual earnings of employees in New York factories averaged $28.16 weekly. This is the highest since 1920.

Wisconsin. In February there was a large gain. The seasonally adjusted index jumped from 106.4 to 112.8. The average during 1921 = 100.

Selected Industries in the United States. This index is not corrected for seasonal variation. In March per capita earnings decreased 0.4 per cent. Of the 52 industries reporting, 27 showed increased earnings per employee. Weekly earnings are still at a high level, exceeded by but two months since 1920.

Cost of Living. The cost of living in the United States, as reported by the National Industrial Conference Board, decreased slightly in February. The index is 98.3, the same as October 1923.

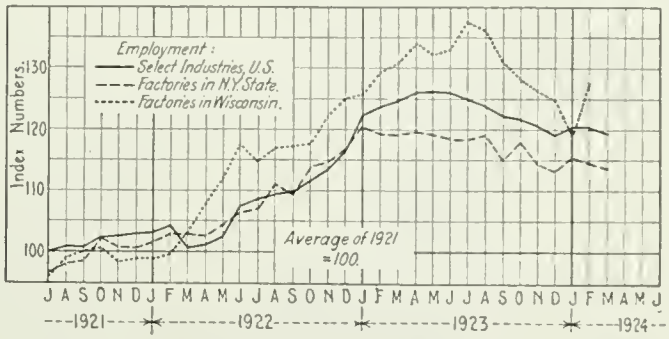
Conclusion. Latest available figures show a further downward trend in the cost of living, together with higher earnings in New York and Wisconsin. Earnings in the U. S. as a whole are slightly down. It is evident that labor's purchasing power is high. Wages are getting far out of line with prices, and financial strain threatens wage disputes.


Cost of Living
Average Weekly Earnings, (Select Industries, U.S.)
Average Weekly Earnings, (N.Y. Factories)
Average Weekly Earnings, (Wisconsin Factories)
Index Numbers
110
100
90
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, U. S. Bureau of Labor Statistics; N. Y. State Dep't of Labor; Industrial Commission of Wisconsin; National Industrial Conference Board

FIG. 14 WAGES AND COST OF LIVING

New York and Wisconsin factories curves are corrected for seasonal variation.


Employment:
Select Industries, U.S.
Factories in N.Y. State.
Factories in Wisconsin.
Index Numbers
130
120
110
100
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, U. S. Bureau of Labor Statistics; N. Y. State Dep't of Labor; Industrial Commission of Wisconsin

FIG. 15 THE TREND OF EMPLOYMENT

Data for all curves have been corrected for seasonal variation.

The Employment Trend

New York State. After correcting for seasonal variation, employment decreased 1 per cent in March. The actual number employed remained practically unchanged.

Wisconsin. The index which is adjusted for seasonal changes, increased sharply in February from 118.8 to 127.8.

United States. After adjustment for seasonal variation, the index decreased from 120.6 to 119.3 in March. The actual figures also showed a slight increase. Comparing identical establishments in both February and March, 27 of the 52 reported increases in employment.

Conclusion. March figures indicate a decline of about 1 per cent in both New York State and United States employment. February returns for Wisconsin, however, showed a notable increase in that state. For the country as a whole employment is well above the average for 1921, but decreasing slightly.

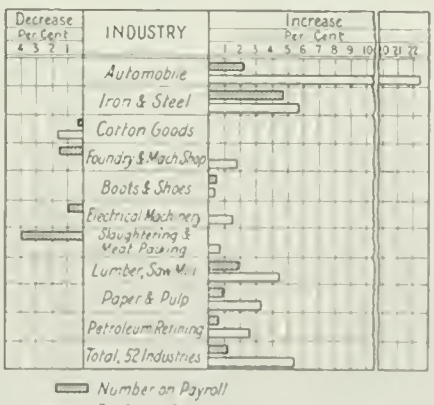


FIG. 16 TREND OF EMPLOYMENT AND EARNINGS, FEBRUARY 1924

Employment and Earnings in Selected Industries

In Fig. 16 the trend of employment and earnings in 10 of the leading industries is analyzed for February.

Employment. Six of the industries showed increased employment during February. The largest increase was in iron and steel, 4.7 per cent. For all 52 industries reporting there was an average increase of 1.2 per cent.

Per Capita Earnings. The most notable fact was the gain of 22.4 per cent in the automobile industry. It was due to a large February increase in full time operation. There was but one decrease in the industries considered, cotton goods falling off 1.7 per cent. For the total of 52 industries reporting there was an average increase of 5.4 per cent. March figures will not be so favorable.

Immigration and Emigration

The number of immigrants again fell off during February. The actual figures follow:

	Immigrants	Emigrants	Net Gain
Dec. 1923....	55,794	9,480	46,314
Jan. 1924....	33,878	5,723	28,155
Feb. 1924....	29,901	3,706	26,195

MATERIALS HANDLING WITH FEWER HANDS

To Modernize~ MOTORIZE Motor-driven machines — derricks, cranes, hoisting and conveying apparatus—load and unload anything from iron ore to live elephants, with equal ease. All products of factory, farm, mine and forest meet at the wharf where nations barter, as did individuals in the village market-places five thousand years ago.

The same compact, powerful, easily controlled machine—the motor—hoists ore from the mine, grain into the elevator, every sort of material from one factory floor to another. It operates long, moving platforms on which motor cars grow like magic, traveling cranes in steel mills, baggage trucks in railway stations, the portable winch that moves about the docks.

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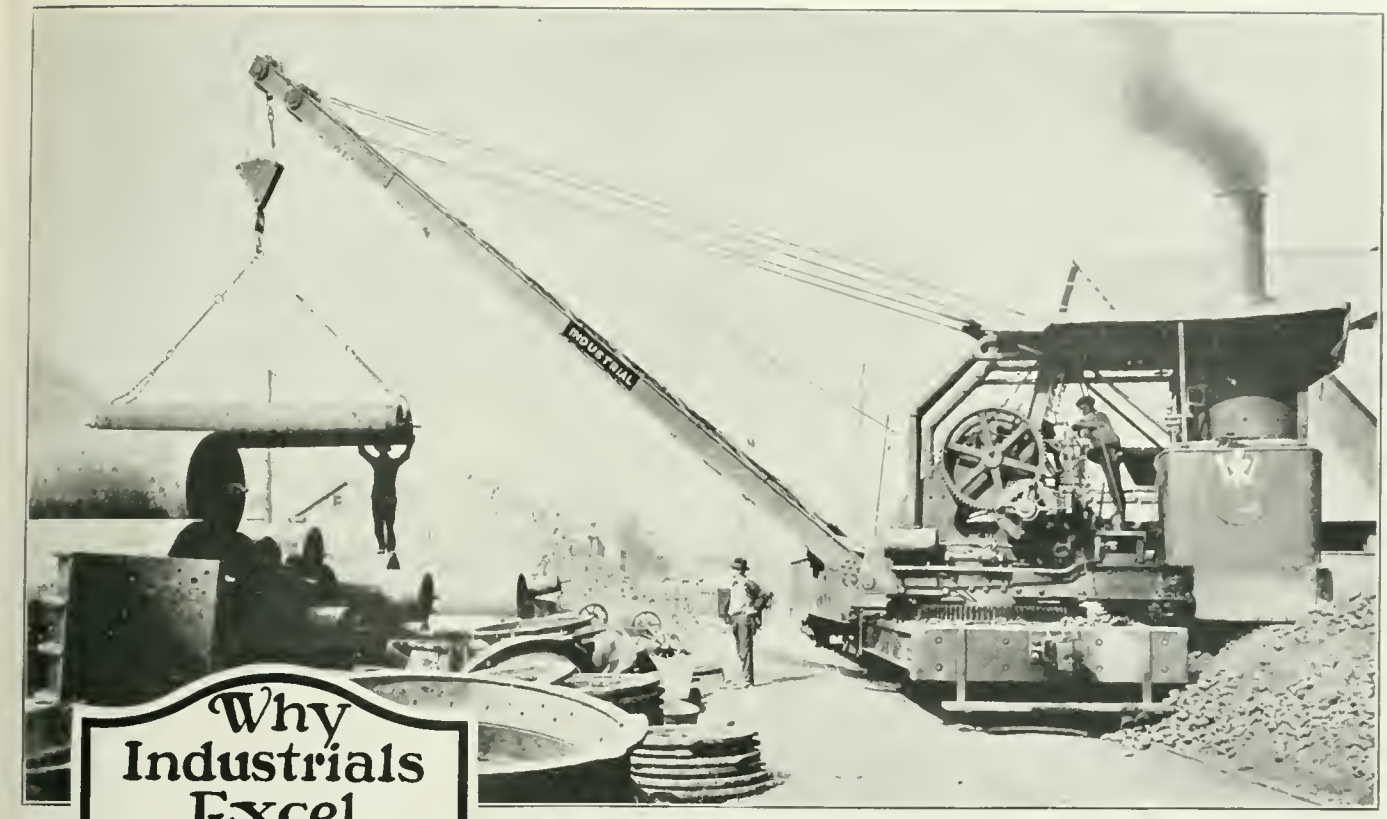
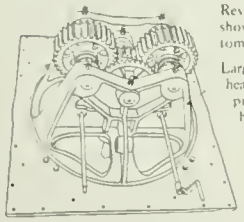


Why Industrials Excel

7 MASSIVE ONE-PIECE BASEPLATE

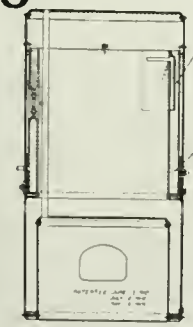


Reverse view showing bottom side up

Large integral heavy-ribbed propelling brackets

This massive one-piece baseplate casting is the backbone of the crane, supporting the revolving upperworks above and propelling machinery below. No other design so well withstands the strains and stresses of severe operation.

8 MODERN SCALE-PROOF BOILER



Feed water enters boiler and passes through purifier—an annular chamber surrounding tubes.

Dirt and scale-forming impurities are deposited as soft mud at bottom of purifier and easily removed

The highest possible efficiency results because 90% of the impurities are kept out of the boiler.

Where Quality Remains, Price is Forgotten

IN A PURCHASING OFFICE just twenty-four years ago all bids were in for the purchase of a new locomotive crane. The company's policy was to purchase the best equipment money could buy, because it meant more years of continued service and lower maintenance costs. As is invariably the case, the INDUSTRIAL was decided upon. That it was manufactured complete from rails to tip of boom in one plant, that it had the reputation of being built for a price and not within a price, and that many years of highly specialized engineering experience were behind the crane, all were influencing factors.

The Warren Foundry & Pipe Co., Phillipsburg, N. J., has two INDUSTRIALS twenty-four years old and one seventeen years old—all still in active service. Where quality remains, price is forgotten. It pays to buy on a quality basis.

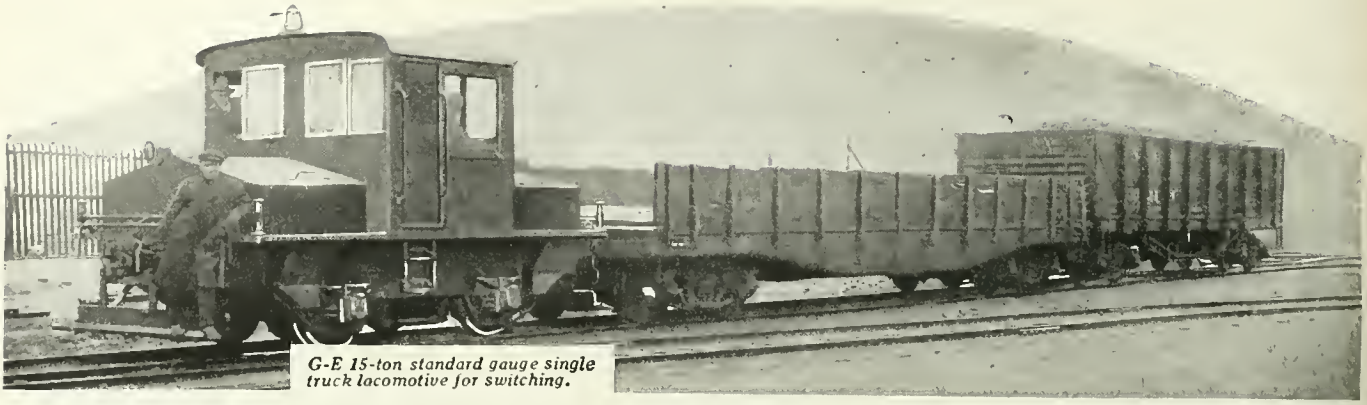
There are 17 standard types of INDUSTRIAL cranes with a capacity range from 5 to 200 tons. All are fully illustrated and described in our Golden Anniversary Catalog, a copy of which will be forwarded to you promptly upon request.

INDUSTRIAL WORKS

BAY CITY - MICHIGAN

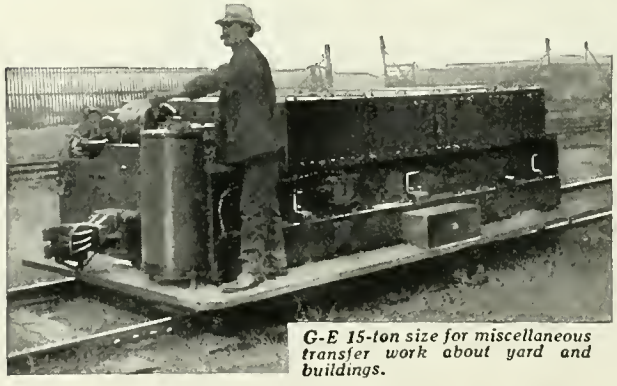
Locomotive Cranes, 5 to 200 Tons -- Transfer, Pillar & Gantry Cranes
Railway Pile Drivers -- Combination Crane Pile Drivers -- Transfer Tables
Portable Rail Saws -- Grab Buckets -- Magnets -- Steam Pile Hammers

INDUSTRIAL LOCOMOTIVE CRANES



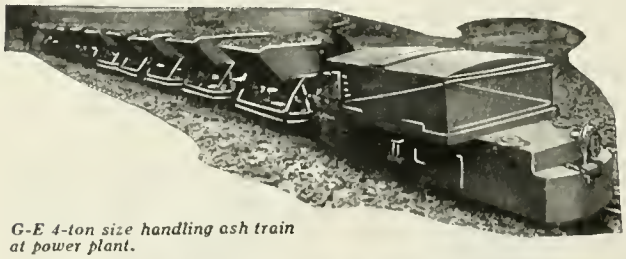
G-E 15-ton standard gauge single truck locomotive for switching.

G-E 40-ton combination storage battery and trolley locomotive for heavy duty yard service.



G-E 15-ton size for miscellaneous transfer work about yard and buildings.

G-E 10-ton platform capacity type for exchanging material between buildings.



G-E 4-ton size handling ash train at power plant.

There Are Many Uses For G-E Storage Battery Locomotives

Whether switching loaded freight cars—transferring raw material, or partially finished products from building to building—hauling ashes or refuse—G-E Storage Battery Locomotives speed up production through facilitating transportation of materials.

With this type of electric locomotive, neither trolley nor third rail is required—and it is possible to reach points in shops, yard or mill where the use of other methods of haulage is not feasible. A G-E Storage Battery Locomotive can be run inside of building and in other localities where the smoke and fire risk of a steam locomotive would forbid its use.

The large type G-E Storage Battery Locomotives are now demonstrating that the yard shifting work in industries can be handled at a lower cost per ton mile.

Interesting and valuable detail of the uses of electric locomotives for industrial haulage is contained in *Bulletin No. 44251* which will be mailed you free upon your request. Write for it today.

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GENERAL ELECTRIC

43B-775

MANAGEMENT AND ADMINISTRATION

VOLUME VII MAY, 1924 NUMBER 5

The Southward Trend of Manufacturing

The Piedmont Section of the Carolinas—I

By RALPH G. MACY

Consulting Mechanical and Electrical Engineer

STARTING at the Virginia line, just southeast of the Blue Ridge Mountains, there is a strip of land stretching across North and South Carolina some 250 miles long and some 75 miles wide. Within this section there has taken place in a comparatively few years a rapid but steady industrial and commercial growth, with an accompanying increase in wealth, which has not been equaled for a like area in recent years by any section of the United States.

This section covers wholly, or in part, 29 of the 100 counties which comprise the state of North Carolina, and 11 of the 45 counties which comprise the state of South Carolina. A glance at Table 1 will present to the reader the area and population of the Piedmont section in their relation to the Carolinas. The increase of 13 per cent in the percentage of population over the percentage of area is one indication of the exceptional conditions that exist in this section.

A few facts concerning the states of North and South Carolina will be of assistance in showing the condition and growth of the Piedmont section as a whole.

Index Number
38(75) Industries in the South

North Carolina, as previously stated, contains the greater part of the Piedmont section. Among the states it ranks second in the Union in the manufacture of cotton goods and first in the value of its manufactured tobacco products. It ranks second in the quantity of tobacco produced and requires one-fourth of the entire tobacco crop of the country to supply its factories. Over 40 per cent of the total value of the manufactured products of the state is represented by the value of the cotton goods industry and the tobacco products. Further, it ranks second in the manufacture of furniture.

Again, it is fourth among the states in the value of its principal crops, and the value of the crops per acre has increased from $22.10 in 1909 to $48.60 in 1922, which was the greatest value per acre in the United States for that year. Industrially, South Carolina has

Courtesy of J. E. Sirrine and Co.

FIG. 1 WOODSIDE COTTON MILL, GREENVILLE, S. C.

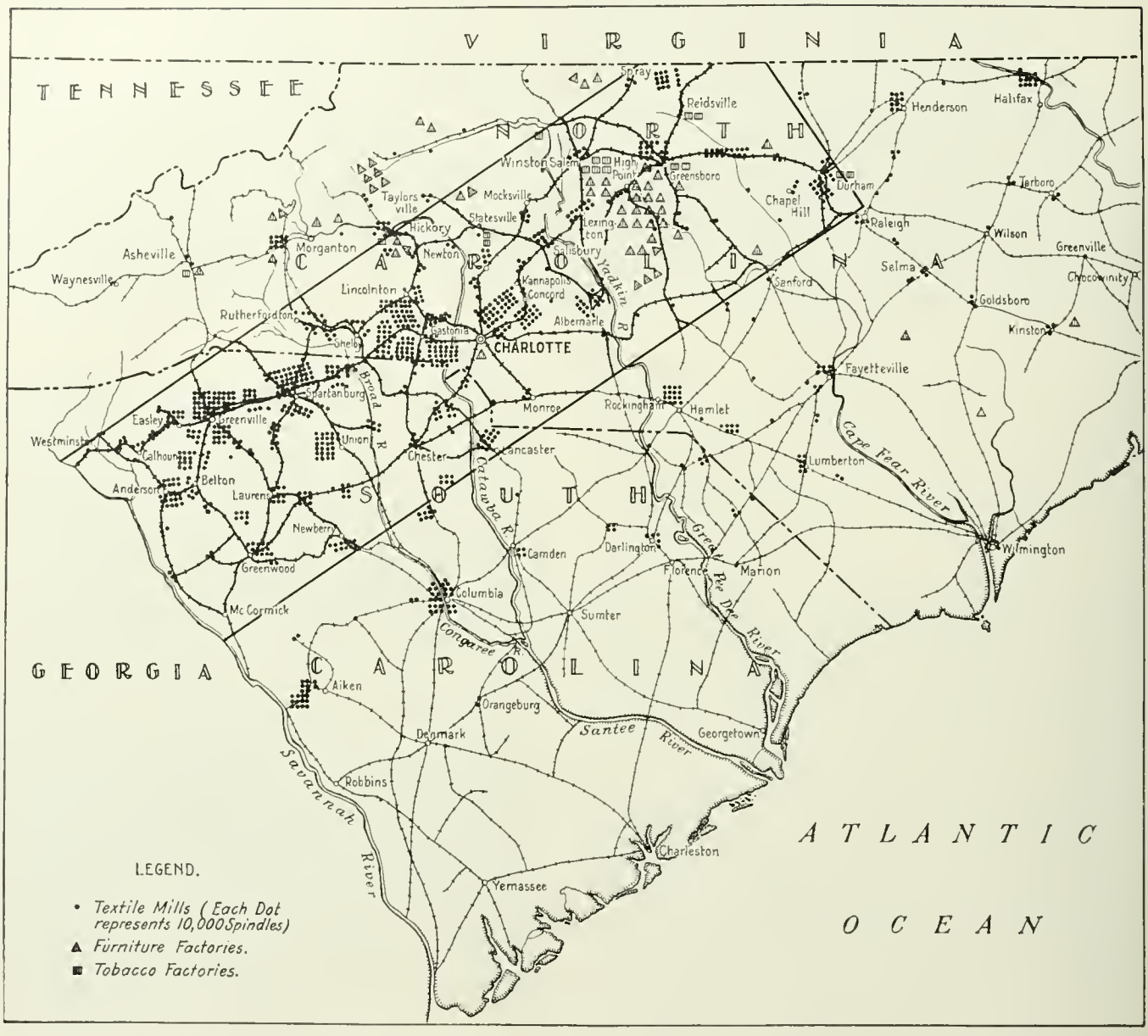


FIG. 2 MAP SHOWING LOCATION OF INDUSTRIAL PLANTS IN THE PIEDMONT SECTION

its textile mills, cotton fields, a great lumber industry, and its fertilizer plants.

Some idea of the position that these states occupy with respect to the main industries of the Piedmont section will be realized when it is noted that North and South Carolina produce one-seventh of the cotton crop and one-fourth of the tobacco crop of the United States.

As a locality, the Piedmont section in the northern portion contains great tobacco plants, knitting mills, and colored goods mills. Here, also, is the furniture industry which obtains lumber from the wooded slopes of the Blue Ridge Mountains. In the central portion are concentrated the cotton yarn mills (Fig. 1) and in the southern portion are the gray goods and sheeting mills, and the bleaching and finishing plants. There are many other industrial activities in this area, such as the manufacturing of aluminum, fertilizer, farm implements, automobiles, and chemicals, but these cannot be discussed here.

Table 1 shows that approximately two-thirds of the Piedmont section lies in North Carolina and one-third in South Carolina. This situation makes it extremely difficult to obtain absolutely accurate figures for the section, records concerning certain parts of the counties of these states are lacking. However, the figures used in this article, and those which will follow, are of sufficient accuracy to give a clear idea of existing conditions and the growth of this section of the two states.

Interesting figures in Table 2 concern the population of North and South Carolina and the Piedmont section.

The death rate is comparable with that of the rest of the country and for the white people is considerably below the average for the United States. The birth rate in both states is above that of the United States and in North Carolina it is higher than in any other state in the Union. In illiteracy the figures are not so satisfactory. However, here again, if the white population is considered, South Carolina, with 6.6, ranks well in comparison with the factor 6 for the United

States. The higher figure of 8.2 for North Carolina is due to the presence of hill people who have come down from the Blue Ridge Mountains where schooling is difficult to obtain. The majority of these people are now living in mill villages and are receiving every educational advantage. Their presence is also shown by the increased percentage of whites in the Piedmont section of both states, over the percentage of whites in the remaining portions of the states. Their value to the community will be touched upon more fully in a following article concerning the labor of this section, its training and effectiveness.

The main industries of the Piedmont section are textile, tobacco, and furniture. Table 3 shows the figures for North and South Carolina for agriculture and textiles. In the case of the knitted goods industry figures given apply only to North Carolina. As the majority of the tobacco plants, and furniture and miscellaneous factories are also located in the northern end of this section only figures for North Carolina are given for these industries.

It will be remembered that the years between 1915 and 1921 were exceptional in the industrial history of this country. During this period there occurred the tremendous inflation due to the war followed by severe deflation. Therefore it is unwise to use any figures from this period. However, some of the government figures for the industries were not obtainable for 1912 and 1922, but those given showing the increased value for the various manufactured products throughout the United States will convey some idea of the growth of this area when compared with that of the entire country.

The main factors responsible for the remarkable growth of the Piedmont section are climate, raw materials, power supply, labor situation, nearness to markets, transportation facilities, and financial and political situations. As the power supply, labor situation, and transportation facilities will be discussed in detail in another article the main points of interest pertaining to these factors can only be touched upon here.

Geographically the Piedmont section is a rolling plateau at the base of the Blue Ridge Mountains, ranging in elevation from 1000 ft. to 450 ft., with a gradual slope to the eastern coastal plain and toward the south. The adjacent mountains are responsible for a large portion of the many advantages which this territory enjoys and this basic fact is appreciated by the people. In these mountains rises the Catawba River, whose development has produced so large an amount of the hydroelectric power used in this section. Upon the mountain sides grows the timber which supplies the furniture factories of Winston-Salem and High Point.

The climate is excellent. Table 4 showing the temperature and precipitation for the northern and southern extremity of this territory.

The cool nights throughout this part of the Carolinas, which afford an opportunity for sleep and recuperation, no doubt play an important part in the vitality of the people.

TABLE 1. COMPARISON OF AREAS AND POPULATIONS OF THE PIEDMONT SECTION AND THE CAROLINAS

State	Area of State (Sq. Miles)	Area of Piedmont Section (Sq. Miles)	Per Cent in Piedmont Section	Population of State	Population of Piedmont Section	Per Cent of Population in Piedmont Section
North Carolina	52,250	12,250	23.4	2,559,123	1,010,956	39
South Carolina	30,570	6,500	21.2	1,683,724	534,828	32
Both States	82,820	18,750	22.5	4,242,827	1,545,793	36

TABLE 2. COMPARISON OF CERTAIN POPULATION FACTORS IN THE PIEDMONT SECTION, THE CAROLINAS, AND THE UNITED STATES[1]

State	1921 Death Rate			1921 Average Birth Rate Per M.	Illiteracy 1920			Percentage of Whites	
	State Average Per M	White Per M	Black Per M		State Average Per Cent[2]	White Per Cent	Black Per Cent	States	Piedmont Section
North Carolina	11.3	9.9	14.4	33.8	13.1	8.2	24.5	70	80
South Carolina	11.9	9.8	14.6	29.5	18.1	6.6	29.3	49	65
United States.	11.7	.....	.....	23.7	6				

[1] Percentage of whites in Piedmont Section, 71.
[2] Over 10 years of age.

TABLE 3. VALUE OF PRODUCTS IN PRINCIPAL INDUSTRIES OF THE PIEDMONT SECTION

Industry	Value of Product		Percentage of Increase	Increase in Value of Products in U. S. in Per Cent	Percentage Manufactured in Piedmont Section
Textiles:	1912	1922		1914-1921	
South Carolina—Cotton Goods	$69,475,000	$229,670,691			
North Carolina—Knitted Goods	52,868,689	180,218,000	240	150	80
Total	128,424,049	437,241,045			
	1912	1922			
North Carolina: Tobacco	35,932,000	214,830,000	497	114	98
	1910	1922			
Furniture	11,232,000	30,288,761	170	100	80
	1912	1922			
Miscellaneous Factories	86,030,562	149,368,476	74		44
Total Value of Manufactured Products	1914	1921			
North Carolina	289,412	665,118,000			
South Carolina	138,819	236,421,000			
Total	428,331	901,539,000	110	80	
Agriculture:	1910	1922		1910-1922	
North Carolina	131,072,000	382,700,000			
South Carolina	137,379,000	204,700,000			
Total	268,451,000	589,400,000	119	44	

TABLE 4 TEMPERATURE RANGE AND PRECIPITATION FOR THE EXTREMITIES OF THE PIEDMONT SECTION

	Northern Extremity	Southern Extremity
Mean maximum temperature.	70.8 Deg. Fahr.	71.1 Deg. Fahr.
Mean minimum temperature.	47.2 Deg. Fahr.	47.6 Deg. Fahr.
Mean temperature for the year	58.6 Deg. Fahr.	59.1 Deg. Fahr.
Precipitation for year.	44.67 In.	51.6 In.

A study of the precipitation chart shows that the greater rainfall takes place during June, July, and August in the growing season, and then in the form of showers, while the harvesting season—September, October and November—has considerably less. This situation appears to be partly responsible for the agricultural prosperity of this region. Following is the seasonal precipitation for an average year in inches:

	Spring	*Summer*	*Autumn*	*Winter*	*Year*
Piedmont Plateau.	11.37	16.00	8.85	11.00	47.22

This section has also a source of wealth in its soil. In 1922 in South Carolina 2,141,300 acres were devoted to cotton, 807,200, or some 37 per cent, being in the Piedmont section, whose area is but 21 per cent of the state. In North Carolina in the same year 1,432,087 acres were devoted to cotton, 415,010, some 29 per cent, being in this section, the area of which is 23 per cent of the state. This shows the agricultural activity.

Power Supply

With regard to the power supply, the Piedmont section is second to none. It is located at the eastern end of one of the largest and most highly developed power systems in the world. This system extends from Goldsboro, North Carolina, on the east to Muscle Shoals, Alabama, on the west, a distance of approximately 550 miles, crossing the states of North Carolina, South Carolina, Georgia, Tennessee, and Alabama. The greatest distance north and south is from Nashville, Tennessee, to Montgomery, Alabama, some 275 miles. Current is transmitted throughout this vast territory at 100,000 volts, 3-phase, 60 cycles. The greater part of the energy consumed in this territory is generated by seven large companies, one of which, the Southern Power Company, supplies the greater part of the power demanded by the Piedmont section. Its main lines run through that part of the section where the cotton spindles are thickest which is no doubt responsible for the location of many of the mills. Approximately seven-tenths of the power sold is generated by 10 hydroelectric plants and it is interesting to note that 9 of these are located on the Catawba River.

One of the major factors that has contributed materially to the development of this section has been the opportunity afforded to the mill-owners to purchase power cheaper in most cases than they could manufacture it. By the purchase of this power they were enabled to use the money that would otherwise have gone into the construction of power buildings, and the installation of boilers, engines, generators, etc., for the purchase of textile machinery, thereby increasing the producing capacity and output for the same capital investment.

The Southern Power Company has installed in its hydroelectric plant a generating capacity of 375,650 kva., and in its steam plants, 92,750 kva., making a total of 468,400 kva. The other companies in this section have an installed generating capacity in both hydroelectric and steam plants of some 38,500 kva. Some of the cities have small individual installations of generating equipment which are used in most cases for standby service. The Southern Power Company sells to municipalities, public utilities, and direct to individual mills when the demand for current reaches a certain amount, and retails current in only one city in its territory. The Aluminum Company of America is not considered as it uses most of the power produced in its own plant and exports part of the remainder out of this section.

A rough estimate of the distribution of the energy generated by the Southern Power Company is as follows: textile mills 80 per cent, public utilities 10 per cent, miscellaneous factories 10 per cent. In 1916 this company sold 458,285,872 kv. hr., and in 1922 it sold 1,001,026,319 kv. hr., an increase of practically 122 per cent in six years, which is another indication of the industrial growth in this section.

Labor Supply

The labor situation is particularly interesting. In the Piedmont section over 98 per cent of the labor is American born of American parentage, which is a striking figure when compared with the corresponding 37 per cent for the state of New York.

This situation, from the viewpoint of the textile industry, during its period of growth was ideal. Not only was there white farm labor to draw upon, but the mill-owners looked to the mountain regions for additional man-supply. These people are of pure English stock, but living under conditions of primitiveness and poverty. The mill-owners, by building modern mill villages, offered them living conditions far better than the large majority had ever known in their native hills. The labor situation, therefore, with regard to this industry, is a tenant proposition throughout the larger part of the Piedmont section. The modern mill villages, and many of the older ones as well, have paved streets, sidewalks, sewers, water, and electric lights. Schools are built and maintained and teachers employed for the children of the operators. Medical care is provided, and community houses offer every facility for entertainment. This situation, coupled with the native suspicion that many of these people have of a man from another section of the country, has made it extremely difficult for the union organizer or agitator to make much progress. The high mechanical perfection of the cotton-mill machinery has made it possible to train these people with considerable rapidity, and they make splendid operators. In fact, some of the goods produced by these mills sells at premium prices.

However, there is undoubtedly a shortage of technical men and executives. Many of these cotton mills

were started by merchants and bankers, and 20 years ago the need was not felt for men with technical training. However, in late years the realization of the value of this type of man to the industry has gained ground rapidly, and also the realization of the value of a certain amount of research work in connection with this industry.

The tobacco and furniture plants are located in or near the cities of Winston-Salem, Durham, and High Point, North Carolina, where the labor situation does not have the features that exist in the mill villages. However, some of the furniture plants maintain factory villages and in these the conditions are excellent.

Courtesy of J. E. Sirrine and Co.

FIG. 3 REPUBLIC COTTON MILLS VILLAGE, GREAT FALLS, S. C.

Transportation

The Piedmont section is some 740 miles from the great metropolitan district where large quantities of its textiles, tobacco, and furniture are disposed of, and some 950 miles from the finishing and printing plants of New England, to which it sends a large quantity of its cotton goods. The transportation facilities are excellent and the Southern Railroad with its associated companies handles a large portion of the traffic. This system has some 1135 miles of track in this section, 263 miles being double-tracked. The other companies serving this section have approximately 350 miles of trackage.

A rough estimate of the percentage of textile and tobacco traffic moving west and north is of interest. For tobacco, approximately two-thirds is shipped west and one-third north; and for textiles, approximately one-third is shipped west and two-thirds north. The freight receipts from Charlotte, which is located in the center of this area, are given in Table 5 and show strikingly the increase in materials handled.

From the standpoint of highways this area is in excellent condition. The people of North Carolina in particular appear to realize the importance of good roads in the development of their state. Since 1920 this state has issued bonds to the extent of $65,000,000, and has at its disposal $6,000,000 federal aid, making a total of $71,000,000 which is being spent on road work, exclusive of the millions of dollars spent by the counties. This state had road work in progress in the year 1923 which totaled $39,053,504, of which some $18,754,522, or 46 per cent, was being expended for roads in the Piedmont section. South Carolina has not authorized any amount of road work approaching these figures. However, this state has expended some $562,000 on the roads in this area.

Financially this section has made remarkable progress and is in a strong position. It was not possible in many cases to obtain figures referring to this area in particular, but the figures of these states as a whole give an idea of the situation and the growth that has taken place within the last few years. All of the states of the Union, with the exception of four, showed a sharp decrease in internal revenue in 1923. These four exceptions and their increases are: New Hampshire, 37 per cent; North Carolina, 15 per cent; New Jersey, 4 per cent, and Idaho, 1 per cent. North Carolina for the fiscal year 1922 paid $122,413,329, and in 1923 paid $140,347,366. Of the 11 states in this vicinity the state that ranked second to North Carolina was Virginia, which paid $40,205,124.

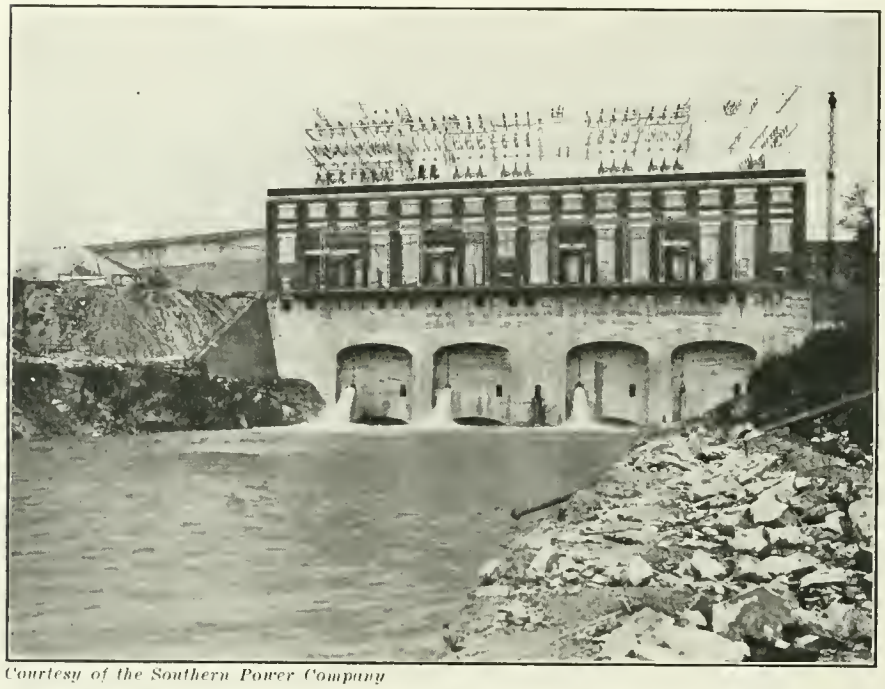
TABLE 5. FREIGHT RECEIPTS FROM THE CITY OF CHARLOTTE, N. C.

	1916	1923	PERCENTAGE OF INCREASE IN 7 YEARS
Forwarded	$496,676	$972,972	96
Received	802,403	2,001,357	149

With regard to taxation and state expenditures, it is interesting to note that the lowest cost per capita for state government for any state in the Union is that of South Carolina which is $2.40, and the second lowest is that of North Carolina which is $2.54.

Table 6 shows the total resources for the banks of North Carolina and the remarkable growth of banks other than National, that is, state savings banks, private banks, and trust companies.

With regard to textiles, in which is invested a considerably greater sum than in any other industry in this section, there is a diversity of opinion as to just how the mills were financed. The consensus seems to be that since the war a large part of the financing for new mills has been done locally, and that at present some 70 per cent of the stock of the mills is owned by Carolina people. The local people, having prospered with the remarkable growth of this section, had but few places to invest their money. There were banks and mortgages, with a certain stipulated return, on the one hand, or the textile mills and tobacco companies on the other. They were aware of the success of the cotton and tobacco industries and invested accordingly.



Courtesy of the Southern Power Company

FIG. 4 MOUNTAIN ISLAND PLANT OF THE SOUTHERN POWER COMPANY. CAPACITY 75,000 KVA.

TABLE 6. BANK RESOURCES OF NORTH CAROLINA

RESOURCES OF ALL BANKS	RESOURCES OF BANKS OTHER THAN NATIONAL		PERCENTAGE OF INCREASE IN 9 YEARS IN BANKS OTHER THAN NATIONAL
Dec. 31, 1923	Dec. 31, 1914	Dec. 31, 1923	
$474,117,609	$81,783,436	$298,995,604	265

Politically, the situation is interesting and significant. Good judgment has been shown by the legislatures of both states in fostering the industrial growth of this section. In South Carolina the governor is elected every two years and may be a candidate to succeed himself. The legislature meets every year. The labor laws allow a 55-hr. working week but prohibit children under 14 from working in the mills. In North Carolina the situation is somewhat unique in that the governor who is elected for four years, cannot be a candidate to succeed himself. The legislature meets once every two years and can only be in session 60 days during this period with pay.

The cities of the Piedmont section strongly reflect the industry in their locality. In the southern part of the section is Greenville, South Carolina. This city had in its incorporated limits a population of 23,127 in 1920. At the present time it claims a population of over 29,000, and with the people of the mill villages on its outskirts this number exceeds 58,000. The atmosphere is largely textile and many agencies for textile machinery are located in this city.

In the northern end of this section is Winston-Salem, North Carolina, with its tremendous tobacco factories, knitting mills, and furniture plants. This city, in 1920, had a population of 48,395, but now claims over 60,000 people. In this same vicinity are High Point, with its furniture factories, and Greensboro, with its textile mills and extensive insurance business. The latter had a population of 19,861 in 1920, but now claims a population of 45,525.

Charlotte, North Carolina, is located approximately in the center of the Piedmont section and its activities are probably more diversified than those of any of the other cities. It had a population of 46,338 in 1920, but now contains over 63,000. It is an interesting city from many viewpoints. Here are located the agencies for many northern firms for machinery, construction material, electrical equipment, and it is an automobile distributing city. The Ford company is erecting a plant there costing $2,000,000 which will assemble 400 cars per day.

Few sections of this country, with regard to industrial development are in the position of the Piedmont section of the Carolinas. In conjunction with its natural resources it has an unusual people, possessed of energy, resourcefulness, and business ability fully demonstrated by the growth of this section. With its location and climate, its waterpower and labor supply this section in the coming year should have a growth even more remarkable than that which has occurred during the past decade. It is a privilege to express appreciation of the assistance of all the civic organizations and individuals in the Piedmont section who made possible the securing of the data appearing in this series of articles. Special appreciation is due C. O. Kuester, Vice-President of the Chamber of Commerce of Charlotte, and C. Ritter, Manager of the Chamber of Commerce of Winston-Salem, for the information they made available not only for their own cities but also concerning the section as a whole. Without this aid the task would have been impossible of completion.

(To be continued in the June issue.)

Organizing a Great Industrial

Tuning-up General Motors—V[1]

By C. S. MOTT

Vice-President, General Motors Corporation

Index Number
658.16 Organization
658.9:629.113 Automobile industry. Management

IN speaking of the principles of organization as applied to a large corporation I must naturally speak of General Motors as one of the largest of our industrial activities and one with the administration of which I have been connected for several years.

General Motors is made up of 62 divisions and subsidiary and affiliated companies. The public is perhaps most familiar with the names and the products of the six vehicle divisions—Buick, Cadillac, Chevrolet, Oakland, Oldsmobile and General Motors Truck—but besides these the General Motors family includes many parts and accessories factories, assembly plants, and other industrial activities. These are located in 12 states and the Dominion of Canada in the western hemisphere, and in the British Isles in the eastern hemisphere. Closely allied with this are the activities of our export company with its 18 distributing centers. From these strategic points, the sales and service of General Motors are extended to 144 countries.

Assets and Activities

The assets of General Motors are in excess of $565,000,000. It has more than 70,000 stockholders and more than 135,000 employees. Added to the latter are many times this number of other workers, who depend upon the managing and operating efficiency of the corporation. It would be difficult to make even an approximate estimate of the total number of families and individuals directly associated with General Motors; there is scarcely a town in America in which one or more divisions of the organization have not an establishment engaged in serving the public.

The enormously varied activities and the armies of men and women for which General Motors is responsible have established a tremendously complicated industrial fabric. The fundamental problem is, of course, to run this business at a profit and at the same time to operate it constructively. Operating a business constructively means to increase not only its intangible assets but its tangible assets as well.

Briefly, all this is accomplished by the proper organizing of the corporation's man-power and by placing a very definite and individual responsibility on the various executives. There has always been, and doubtless always will be, a good deal of discussion as to the best methods of organization and operation, but certain fundamentals are common to all business undertakings. Any plan adopted should crystallize policies in such a way as to protect the interests of stockholder, employee, and customer, while at the same time, in operating, there is the least possible restriction on the initiative and the constructive ability of the individual.

It is generally recognized that men are more important than plans, but the best men work best by following the best plans. It is a General Motors policy to decentralize control, at the same time taking advantage of the strength, resources, and experience of the organization as a whole, so that every General Motors product may represent the greatest possible value to the customer.

General Plan of Organization

The chart shown in Fig. 1 gives a graphic presentation of the operating organization of General Motors.

In detail, General Motors is governed by the stockholders, through the board of directors and its chairman. The active management of the corporation is in the hands of the president, who is subject to the control of the Executive and the Finance Committees. In the formulation of the corporation's financial policy, the vice-president who is chairman of the Finance Committee governs. The financial staff, necessarily a large and well-organized body, includes in its activities the company's relations with banks, the department of the treasurer and of the comptroller, the insurance department, the tax department, and so on. An important activity of the financial organization within General Motors is the establishment of certain fundamental services, such as those of the General Motors Acceptance Corporation, which assists General Motors dealers and General Motors customers in financing purchases under the deferred payment plan, and the General Exchange Corporation, handling insurance of General Motors products.

Our president is chairman of the Executive Committee and the active head of all our operations. Under his jurisdiction come the financial department, already mentioned, the production and sales activities, gathered together under the head of the operations staff, and the advisory staff.

Organization of Operations Staff

The operations staff is divided into several major groups, each under the charge of a vice-president of General Motors, who acts as a group chief. These groups comprise the Affiliated Companies Group, the

[1] Preceding articles have appeared in MANAGEMENT AND ADMINISTRATION for January 1924, p. 21; February 1924, p. 195; March 1924, p. 283; April 1924, p. 417.

Car Group, the Accessories Group and the Export Group, which in turn comprises General Motors Export Company, and General Motors, Ltd., our British company. The Affiliated Companies Group has for its group chief the president of the General Motors Corporation. The companies in this group are those in which General Motors has a majority stock ownership.

As stated, a vice-president of General Motors is in charge of the Car Group. The activities of this group include the operation of the car and the truck divisions already enumerated and a number of companies manufacturing accessories and other products of general use. It may be mentioned here that the products of General Motors in a number of cases are not utilized solely in General Motors vehicles, but form important component parts of other trustworthy cars. We have, besides, a number of subsidiaries whose products go to the public at large. Important manufacturing and distributing divisions of the corporation are General Motors of Canada, Ltd., Delco, Remy, New Departure, Hyatt, Delco-Light, Klaxon, Jaxon, Fisher Body Corporation, Harrison Radiator, Brown-Lipe-Chapin, Doehler Die Casting, and Lancaster Steel Products. United Motor Service, Inc., on this continent is in charge of servicing the products of several of the accessories divisions, through more than 6000 authorized representatives.

As stated, each of the principal groups or divisions is in charge of a manager, who is a vice-president of the parent corporation. Generally speaking, each division is in charge of a general manager, who has the entire responsibility for the success or failure of his operation, subject only to the clearly formulated policies of the corporation as a whole.

Each division operates as an independent unit, the head of which is practically as independent as if he were the president of a separate company, but at the same time his work is co-ordinated by the functioning of certain committees and the advisory staff described below. Under this arrangement, each division enjoys advantages that would be beyond the reach of individual organizations. Among these may be mentioned research facilities, which furnish what amounts to an engineering audit on design; forecast and control of budget expenditures; forward commitments, with the solid advantages of quantity buying; and a consolidated cash plan, which has worked out to the advantage of everyone connected with General Motors, from stockholder to consumer.

Organization of Advisory Staff

The advisory staff is in charge of a vice-president and is composed of several sections headed by members of the staff. These staff members act in an advisory capacity only; their services are available when they are sought by the divisions and the associate companies.

The chief of the advisory staff heads the directors of the following important sections:

Patent Department. All patent matters pertaining to the interests of the corporation are referred to the head of the patent department, who acts very largely on his own authority as an expert. He has complete charge of, and responsibility in, the divisions of his department located at Detroit, Michigan, at Dayton, Ohio, and at Bristol, Connecticut. These divisions handle all matters dealing with patents, trade-marks, copyright, and related subjects. The work is assigned at the discretion of the department head. All divisions refer all patent matters to him direct and he is responsible for the decisions made. Every month a comprehensive report of the patent department's activities dealing with matters of infringements, inventions, and litigation is forwarded to the executive committee.

Real Estate Section. The real estate section, also under its own responsible head, handles the purchase, sale, or lease of all real property which has been turned over to it by the corporation or any of its divisions. The section acts in the capacity of consultant in all real estate matters. A monthly report is made by its head to the Executive Committee; this report gives the status of all individual parcels of land owned by the corporation. Valuations on these parcels, if a change in valuation from the figure at which they are carried on the books is proper, are made as the result of consultation by the real estate section with other experts familiar with the individual piece of property involved. Offers for property are also referred for consideration to individual experts.

Office Building Section. The General Motors Building Corporation, of which the vice-president in charge at Detroit is the president, is a separate corporation. It has charge of the general office building at Detroit through a general manager and assistants; the general manager reports to the president of the General Motors Building Corporation. The corporation office building at New York is also managed by the same general manager and his assistants. Periodical reports covering the building corporation's operations are made by its general manager to the Executive Committee of General Motors.

Housing Section. Housing activities are operated through another individual corporation, of which a vice-president of General Motors is the president. Active management is under the charge of a vice-president and general manager of the Modern Housing Corporation, the subsidiary; he has entire responsibility for the activities at Flint, Pontiac, and elsewhere. Periodical reports to the Executive Committee are made by the vice-president and general manager of the Modern Housing Corporation.

A very important activity of the corporation's advisory staff is that of the General Motors Research Corporation, which operates at Dayton, the industry's largest experimental and testing laboratories, under the charge of a vice-president of General Motors. The work of the laboratories at Dayton and that of the factory section's laboratories at Detroit, of which mention will be made later, represent a portion of the General Motors' contribution to the advance of the automotive industry. The information and data gathered by the laboratories at Dayton and Detroit are at the service of any division of the corporation for development, experimental, and testing work.

Sales, Advertising, and Service Section. This section is headed by a director assisted by a corps of experts in the several lines that have to do with sales effort, advertisements of various kinds—display and

direct, periodical, and outdoor—and service matters. The director and the experts act as consultants on all matters of sales and service, and recommendations in accordance with their investigations are made by the director to the vice-president at the head of the advisory staff. Proposals for appropriations for advertising are reported on by this section, which also deals with retail sales plans, branch operation, showrooms, service stations, and so on. The final approval of the vice-president in charge is based on the investigations and reports of this section.

Purchase Section. This is similar in its organization to the sales, advertising, and service section. A director and a corps of experts collect and digest data on the requirements of the corporation's divisions for purchases in large quantity. Arrangements are perfected by which each division and plant in General Motors has available the advantages of participating in purchasing its materials on corporation requisition.

Another important activity of the corporation is that of its Purchase Committee, closely allied, by the nature of its work, to the Purchase Section. This committee's regular membership consists of the president, two vice-presidents, the head of the purchase section, the purchasing agents of the vehicle divisions and of an accessory division, and a committee secretary. From time to time representatives from the divisions which are not represented on the permanent committee are asked to attend the committee meetings. Examinations of conditions and markets are conducted, and recommendations, of advantage to the corporation and the divisions alike, are made as the result of the committee's work.

Power and Construction Section. At the head of this section of the advisory staff is a director who reports to the staff's chief. He is a consulting engineer whose services are at the disposal of the divisions in matters

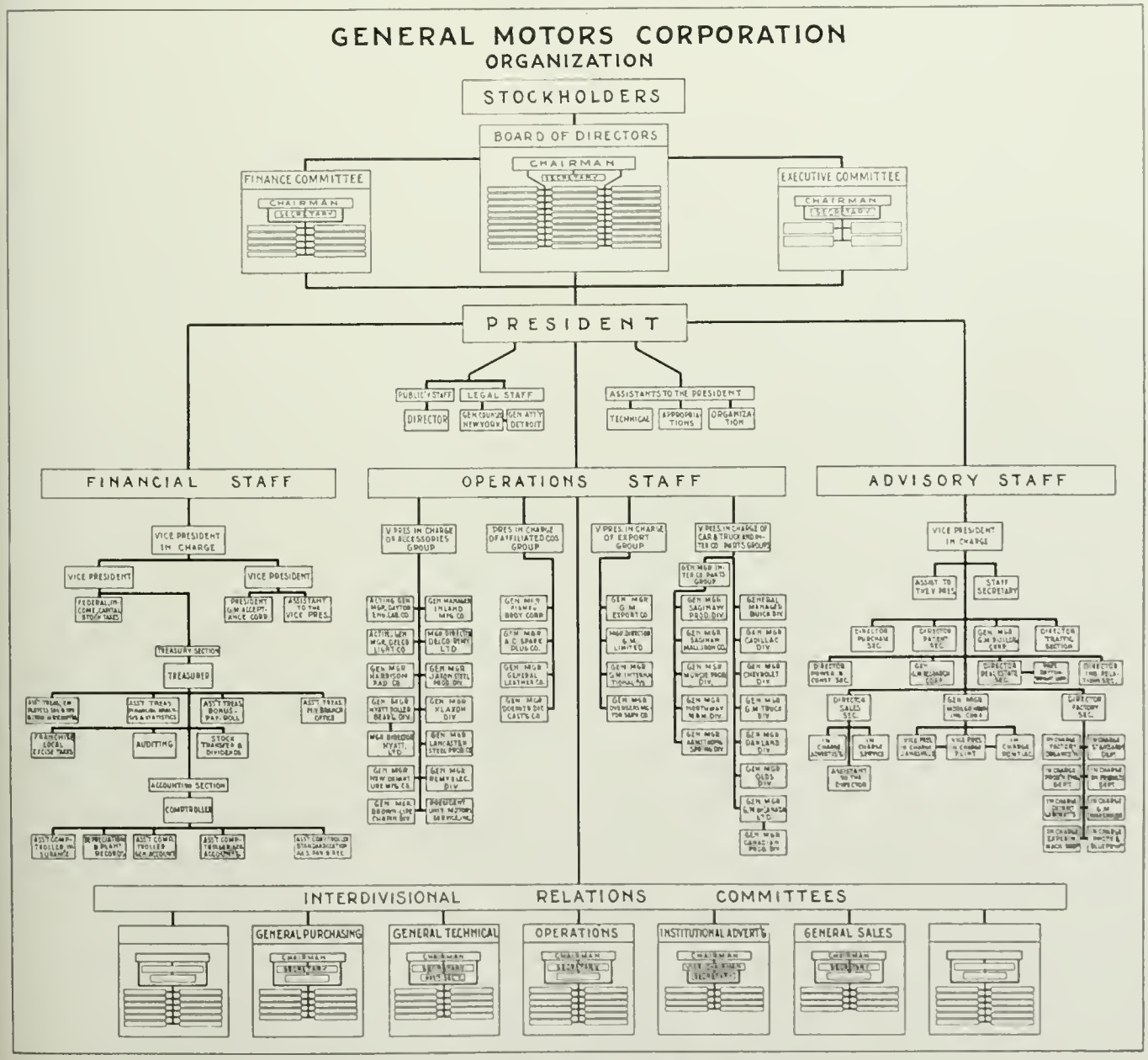


FIG. 1 ORGANIZATION CHART, GENERAL MOTORS CORPORATION

relating to power and construction. His work includes investigation of rates charged for power, a study of fuel supply and markets, and building construction costs. It includes also the collection of data on the efficiency of boilers and ovens, heat-treating plants and allied equipment. He also has charge of negotiations with public utility corporations in matters relating to power supply.

Factory Section. This section is also headed by a director reporting to the advisory staff's head. His section handles a number of important matters, and makes available to all divisions information dealing with production, cost analysis, lubrication, waste prevention, salvage, metallurgical data, standards, factory layout and tool design. Connected with this section are the laboratories at Detroit, previously mentioned. These laboratories are well equipped for making physical and chemical tests and their activities form an important basis for accurate information on production, which is available to all the divisions and subsidiaries.

The same section has charge of General Motors Warehouse, a depository for the corporation's surplus tools and equipment. Sales are made from the stock kept on hand in this warehouse, which acts as a sort of equipment clearing-house among the divisions. All appropriations requests, having to do with matters in which the section is interested, are referred to the section for report before final approval. Special requirements are listed by the divisions and checked by the factory section; wherever possible, machinery on hand is utilized in filling divisional requirements. The director makes a formal monthly report to the staff chief.

Traffic Section. The director of this important section is a vice-president of General Motors, who heads the traffic experts of the corporation and makes available their knowledge and experience for the corporation's individual traffic departments.

Industrial Relations Section. This section operates under a director who works in conjunction with one man in each division to correlate and standardize, so far as possible, matters pertaining to industrial relations. Under his direction also is an expert who works at the central office at Detroit, gathering data on the important matter of industrial safety, and making them available on request.

Committee Organization

In addition to the activities of the operating staff and the advisory staff there are several important committees functioning in General Motors organization. These have been formed for the purpose of pooling experience and co-ordinating information so that each division is given the advantage of as much common knowledge as possible.

Operations Committee. This is made up of the general managers of the car divisions and is headed by the president of General Motors with the principal executives. At the meetings of the committee there are discussed the corporation policies as regards manufacture and distribution.

General Purchasing Committee, General Sales Committee. These committees are similarly constituted, with divisional heads as their members. They function for the same purpose as the other committees of executive heads in divisions—to act as a clearing house of information and to lay out plans of campaign that will have a general application throughout the organization.

General Technical Committee. Emphasis should be laid on the importance of this committee. It is headed by the corporation president, with several of the vice-presidents, the president's technical advisor, the chief engineers of the principal divisions, members of the advisory staff whose work deals with technical matters, the head of the patent section and the vice-president in charge of the accessories group of plants. Other members of the organization are from time to time invited to assist in the deliberations of this committee; the plan is to avoid reaching a definite membership, but because of the importance of the matters discussed, many are invited to be present at particular sessions. Technical matters affecting the corporation and the divisions are discussed and recommendations made.

Institutional Advertising Committee. The corporation's institutional advertising is handled by a committee of which a vice-president of General Motors is the chairman. On the committee are the sales managers of some of the divisions, the presidents of the advertising agencies handling General Motors advertising, the director of the sales, advertising, and service section of the advisory staff and several of his aids, also the president and several vice-presidents of the corporation. Appropriations for institutional advertising are discussed and approved by this committee before recommendation of a budget is made to the Finance Committee.

Operating Details—Forecasting

It will be seen that in General Motors the policies of the corporation are developed as the result of the functioning of these various committees, side by side with the development of financial policies by those in charge of finance.

The operating staff, the advisory staff, and the various committees deal with matters as they arise. In addition to these there is of course necessary the establishment of certain standard methods of handling matters affecting all divisions of the corporation alike.

In the matter of appropriations, a general manager has the authority to make capital expenditures up to a certain amount. If it is a case, for example, of the manufacture of certain parts instead of their purchase from outside sources, he develops a complete estimate of buildings, equipment, and material, shows the amount of working capital required and so on. He lists the estimated savings to be effected by the plan and shows the reasons for individual manufacture. These plans and expenditures must be approved by an executive or a committee, according to the amount of expenditure involved and also according to the scope of the plan. For amounts in excess of those which may be made on the authority of a division general manager, the authority rests with the general manager in conjunction with the group chief and the president; larger amounts are authorized by the Executive Committee; and still larger amounts call for authorization by the Finance

Committee. An Appropriation Committee is responsible for requisitions coming through in proper form and with proper signature.

Inventory, production, and sales forecasts are presented every 30 days, on a blank which covers a period of 90 days. In the case of a report made on October 25, 1923, for example, the blank shows actual inventory at October 1, with estimates for November 1, December 1, and January 1, which of course include commitments already made or to be made, within the period. Production and sales forecasts are given in the same manner and all of the information given as of October 25 is compared with similar information given as of the twenty-fifth of one, two, and three months previous. Thus actual results are compared automatically with previous forecasts; and this tends to secure accuracy in forecasting.

These data are given for the vehicle divisions and for the intercompany parts group as well. On another portion of the blank are set down actual production for October 1923, and estimated sales and production by months for November and December 1923, and January and February 1924. Data are also furnished, showing the total estimated for four months, in all vehicle and parts plants, both in the United States and in Canada. Each month, therefore, opportunity is given to the executives to observe the closeness of relation between forecast and actual results. The figures as they stand are reported by the president of the Executive Committee. The report in the form outlined brings clearly forward the conditions of the individual plant, inventories, and so on.

Up to a certain amount, the general managers of divisions make forward commitments for three months to cover material and other productive requirements of their manufacturing schedules. Beyond that, the approval of the group chief and the president is required. Practically, the forward commitment request is sent to the group chief and the president and unless the division is notified of disapproval within a week commitment is made by the division. The forward commitments are forwarded to the Executive and the Finance Committees for approval and for combining these commitments with the future liabilities of the corporation.

A most important development along financial lines, as a fundamental policy of General Motors, has been the establishment of Consolidated Cash. A plan has been worked out by which the income from the several manufacturing divisions and the other income-producing sources of the corporation is sent to the treasurer, who releases funds on requisition from the divisions as they are required. This financial plan, which operates very much along the lines of the federal reserve system, provides almost automatically for funds where they are needed at the time and makes the liquid assets of the corporation available to the best advantage.

No system of administration can, of course, be entirely free from faults; but in General Motors a judicious combination of the advantages of the decentralized system, with its incentive to individual initiative, and those of a closely knit central organization, has operated to the obvious benefit of the corporation. A consistent effort is made all along the line by General Motors to individualize the divisions and the departments in such a way as to develop their initiative to the fullest extent. At the same time, the organization's composite knowledge and experience are pooled in such a way as to make them available and of value to everyone concerned.

Handbook of Specifications for Commodities Purchased Out of Taxes*

By A. S. McALLISTER

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AS a result of a conference of state purchasing agents held at the Department of Commerce, Washington, D. C., on May 25, 1923, work is now going forward actively in bringing together the satisfactory commodity specifications in preparation for the publication of a dictionary, handbook, or encyclopedia of specifications for commodities purchased by the federal, state, and municipal governments and public institutions. In this work the National Conference of Governmental Purchasing Agents is taking an active part. It is making a thorough canvass of state purchases for the purpose of determining what are the most important items from the point of view of the states as consumers.

In initiating this work contacts were established with organizations representing consumers and with the organizations which speak for all of the major branches of industry, and in several lines similar contacts have been made with the lesser branches of industry, unorganized, as well as organized.

Index Number
6(003) Specifications for commodities
658(02) Business handbooks

In addition to the federal departments and independent establishments more than 450 public purchasing agencies have been communicated with. There has been compiled a list of more than 400 trade associations and technical societies having national recognition which are directly or indirectly interested in specifications. All of these organizations have been requested to supply copies of their specifications for consideration in connection with the compilation of material for the dictionary or encyclopedia of specifications.

The correspondence conducted with the public purchasing agents and the officers of trade associations and technical societies has established the fact that all of the individuals and groups for which the dictionary

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or handbook of specifications is being prepared will welcome its appearance enthusiastically and co-operate actively in its preparation.

It seems safe to state that considerably more than 90 per cent of the specifications issued by the important national technical societies and trade associations and governmental purchasing agencies have already been collected, so that a fairly accurate estimate can now be made of the total number of specifications available for use in connection with the preparation of the dictionary, handbook, or encyclopedia of specifications. Moreover, some kind of a rough guess can now be made of the volume of the material contained in the existing specifications, as follows (Table 1):

TABLE 1. SUMMARY OF EXISTING SPECIFICATIONS

	Number of Specifications	Commodities omitting duplicates (estimated)	Words (Roughguess)
Federal departments	4400	2700	6,500,000
States and cities	2500	1500	2,000,000
American Society for Testing Materials	382	300	800,000
Other technical and trade associations	1500	500	3,500,000
Totals	8782	5000	12,800,000

Not all of the specifications listed can be properly classed as relating to commodities purchased by the federal, state, and municipal governments and public institutions.

Below there is given a summary of 20,000 commodities which can be properly classed as articles paid for out of taxes (Table 2):

TABLE 2. SUMMARY OF LISTED COMMODITIES

	Listed	Omitting Duplicates (estimated)
Federal schedule of supplies	7500	7500
Naval stores	1450	850
Army quartermaster	1900	1250
New York City	2000	1500
Hospital supplies, etc	9100	8900
Total Effective	.....	20,000

From the above tabulations it will be noted that there have already been collected about 9000 specifications relating to about 5000 separate commodities whereas there are more than 20,000 commodities for which there should be specifications.

It is to be understood that in making the estimate of 12,800,000 words, as used above, no allowance has been made for the great amount of duplication in the existing material and the possibility of condensation by combination. Moreover, no allowance has been made for the possibility of eliminating from consideration certain great groups of specifications that are already easily available in convenient form and could probably well be referred to instead of being reproduced in full in any handbook of specifications. The amount of duplication in existing specifications and the possibility of condensation will be appreciated from the fact that there are now on hand about 2000 specifications for food which represent not more than 500 separate commodities. For example, there are 16 separate butter specifications, 23 separate specifications for bacon, and 39 for cheese. After eliminating duplicates there will remain not over 1000 separate specifications for the various kinds and qualities of foods.

Before attempting to make any selection from the large amount of material now available for use in the dictionary, handbook, or encyclopedia of specifications, it has seemed highly desirable to make the collection of existing specifications as nearly complete as possible. There is now being prepared a list of all of the known existing specifications which will be issued in convenient form, properly classified, to be widely distributed for the purpose of obtaining corrections and additions. In addition to providing a convenient means of eliciting some highly desirable information, such a list, although initially somewhat incomplete, will prove of great service to all agencies interested in specifications. In its revised form it will serve as a reliable basis for the selection of specifications for inclusion in the handbook or encyclopedia.

For the purpose of organizing an Advisory Board to co-operate with the Department of Commerce and the National Conference of Governmental Purchasing Agents in the work of compiling material for the dictionary, handbook, or encyclopedia of specifications, there was held on June 11, 1923, a conference of representatives of the various national organizations interested in the preparation and unification of purchase specifications from the point of view of both the producer and the consumer. The following are represented:

American Electric Railway Association
American Engineering Standards Committee
American Hospital Association
American Hotel Association
American Society for Testing Materials
Associated Business Papers, Inc.
Associated for Government Service, Inc.
Chamber of Commerce of the United States
National Association of Manufacturers
National Association of Purchasing Agents
National Conference of Business Paper Editors
National Conference of Governmental Purchasing Agents
National Electric Light Association
Society of Automotive Engineers

The first meeting of the Advisory Board was held on October 24, when there were present representatives from every organization represented on the Board with a single exception. The service which this Board will render is well illustrated by the actions taken at the initial meeting when the Board voted unanimously for the creation by the Secretary of Commerce, as Chairman of the Board, of three committees from its membership to render reports for the approval of the Board on the subjects of (1) classification of commodity specifications; (2) form and size of the publication; and (3) scope of the proposed handbook of specifications.

Surplus and Its Constructive Application

Capital Requirements and Control—VI[1]

By J. H. BLISS

Comptroller, Libby, McNeill and Libby

Index Number
658.14 Financial control
657.41 Capital accounts

SURPLUS accounts are a part of the net worth of a business and represent the equity of the stockholders in the business over and above their capital stock investment. That is, the stockholders' investment in a business consists of the capital stock and surplus accounts. Surplus accounts may result from:

1. Earnings of past periods left in the business.
2. Surplus paid in by the stockholders.
3. Premiums paid on capital stock.
4. Donated surplus arising from donated Treasury Stock, etc.
5. Appreciation of assets, such as surplus resulting from appraisals, etc.
6. Capital profits realized on the sale of fixed investments, etc.

While Surplus account is generally understood to consist of the net earnings left in the business, the more general definition is necessary, as any of the above might yield the stockholders an equity in the business in excess of their initial stock investment.

It is highly essential to maintain a clean-cut distinction between earned surplus and surplus arising from any other source, for disbursements of earnings in the form of cash dividends may properly be made only from earned surplus. The different classes of surplus are discussed in the following sections.

Earned surplus results from earnings realized in the ordinary course of operations, which are left in the business. It is only from earned surplus that cash dividend disbursements may properly be made.

Earnings left in the business are a more important source of capital than is generally appreciated. Following is quoted a table based upon published reports of 227 representative companies for the years 1916 to 1921, both inclusive, showing sources of capital:[2]

	Per Cent
By earnings left in the business	41
By increased current borrowings and liabilities	14
By increased long-term borrowings	12
By new stock issues other than stock dividends	19
By all other sources, such as appraisal credits, etc.	14
Total	100

Statistics on a large number of companies show that representative companies left an average of about 43 per cent of their annual earnings in the business throughout the war and post-war periods closing with 1921. The significance of these figures should not be overlooked. In the case of a going business, the one all-important source of new capital is earnings left in the business.

As earned surplus is transferred to the Surplus account it becomes available either for disbursement as dividends or reinvestment in the business in some form or other. The earned surplus of the business therefore may include both appropriated surplus and free surplus as defined later.

Capital Surplus

Capital surplus is that surplus arising from any source other than net results realized in the ordinary course of operations. It includes surplus paid in by stockholders, premium paid on capital stock, donated surplus, surplus arising from appraisals, reorganization surplus, and all capital profits. Capital surplus should be distinguished from earned surplus as it is not ordinarily available for disbursement in the form of cash dividends. Any disbursement of cash dividends from capital surplus could not be considered a disbursement of earnings, but would be a disbursement of capital. To pay dividends out of paid-in surplus or premiums on capital stock would be returning to the stockholders a portion of their capital investment. Disbursement of surplus arising out of donated treasury stock would not be a disbursement of earnings, and might defeat the purpose for which stock was donated, which usually is to supply added working capital. To pay a cash dividend from surplus arising out of appraisal revaluations, would likely be cash disbursement of unearned or book profits. Such disbursements of unearned profits would be direct impairment of working capital.

In the accounts and financial statements of a business, capital surplus should be distinguished from earned surplus wherever the amount of capital surplus is of any relative importance whatever. The distinction should always be carried out in the accounts, but if the amount of capital surplus is relatively unimportant the distinction might not be necessary in the financial report, particularly if there happens to be a

[1] Preceding articles have appeared in MANAGEMENT AND ADMINISTRATION for December 1923, p. 705; January 1924, p. 26; February 1924, p. 155; March 1924, p. 299; April 1924, p. 405.

[2] From "Financial and Operating Ratios in Management," by J. H. Bliss, p. 187.

very large balance in the Earned Surplus account.

Appropriated surplus means surplus set aside to cover withdrawals from working capital and therefore not available for dividends, perhaps, or any other purpose which would mean further withdrawals from working capital. The purpose of appropriated surplus is to protect the working capital position of a business. As earnings are realized, they appear first in the form of added working capital. Sinking fund payments, additions to fixed properties not specifically financed, and similar items are withdrawals from working capital. Any such withdrawals not specifically financed have to come out of earnings left in the business. Hence, the conservative policy of making appropriations of surplus, has the effect of withholding a like amount of earnings in the business and thereby protecting the working capital position.

As a general rule appropriated surplus should come from earned surplus. Surplus paid in by stockholders, donated surplus, and similar items are usually received for the purpose of supplying added working capital requirements. To use this class of surplus in making appropriations to cover additions to fixed property investments would defeat the purpose for which the surplus was paid in or donated.

Capital surplus arising from revaluation of properties does not increase working capital; consequently such surplus would be unavailable for use in making appropriations to protect working capital. Capital profits realized on the sale of fixed investments and similar items might mean added net working capital and hence might properly be used in making appropriations to cover additions to fixed investments. These, however, are relatively unimportant. The better rule is that an appropriation of surplus made for the purpose of protecting working capital should come from Earned Surplus account.

Free Surplus

Free surplus is the balance of Earned Surplus account remaining liquid in the business in the form of working capital and available for disbursement as dividends or appropriation to cover withdrawals from working capital. This classification of Surplus account is not commonly noted, but is highly important in the conservative handling of the financial affairs of a business.

To the uninitiated a large Surplus account too often indicates large dividend possibilities, but it is not the uninitiated alone who are often misled. Not many business men know or have any idea just what part of the Surplus account of their company is in reality free surplus, available either for cash dividends or for investment in fixed property, or available for other fixed expenditures which withdraw funds from working capital. Experiences of companies in the past, and in the present as well, indicate that the number who realize the true character of their surplus accounts is all too few.

The history of reorganizations, receiverships, and transfers of business, contains countless examples of companies which came into financial difficulties through overexpansion or shortage of working capital. Overexpansion is generally the first error, and shortage of working capital the result. How many men spend money because they have it, who would not spend it if they had to go out and borrow the funds beforehand? How many business men have expanded their facilities when funds were at hand, whereas they would probably hesitate and work existing facilities harder, if they realized that they had, as a matter of fact, no free surplus funds available, and that expenditures would mean either new financing or impairment of working capital?

Protecting Working Capital Position by Analyzing Surplus

Unfortunately the general conception prevails that surplus is simply past earnings left in the business, the present status of which may not be determined. This is not the case. It is unfortunate for the reason that this failure carefully to consider the disposition of earnings in a business has probably been the most fruitful source of unsound and unconservative business and financial policies.

The plain facts are that funds realized out of earnings cannot be spent for additions and betterments to plants, for retirement of bonds, or otherwise permanently invested, and still be available for the disbursement of cash dividends. Only free surplus may properly be used for disbursement in cash dividends, and by free surplus is meant earnings of past periods, which have not already been spent or permanently tied up in investments. The recognition of this principle is absolutely essential to a sound financial policy.

The Surplus account of a business can and should be analyzed in such a manner as to determine the present form of these earnings left in the business. That is, whether or not they are on hand as working capital, or have already been used in retirement of bonds or additions to fixed properties, or some other purpose withdrawing them from working capital. A method of making this analysis is illustrated in the following section. This analysis of Surplus account should be carried in all financial statistics of the business prepared for internal use.

Method of Analyzing Surplus

The following tables show a method of analyzing the Surplus account of a business, and determining the elements of free surplus. The illustration is based upon the published reports of a well-known and representative manufacturing business.

Presented first on the financial reports as published, consisting of a comparative balance sheet covering the years 1913, 1920, 1921, and a statement of the earnings, dividends, and surplus for the years 1914 to 1921 inclusive. Following these reports is an analysis showing the new funds from profits, unexpended reserves, earnings used in reduction of good-will or written off and also funds secured by long-term borrowing. The disposition of these new funds and the effect upon surplus is also shown. The fiscal year ends October 31.

BALANCE SHEET OF A REPRESENTATIVE INDUSTRIAL COMPANY

	1913	1920	1921
Assets			
Cash	$963,000	$2,777,000	$1,891,000
Accounts and Notes Receivable	10,866,000	10,946,000	8,445,000
Inventories	10,408,000	13,359,000	13,286,000
Other Current Assets	266,000	1,221,000	24,000
Total Current Assets	$22,503,000	$28,303,000	$23,649,000
Deferred Charges		386,000	679,000
Investments		725,000	884,000
Fixed Assets Tangible	9,358,000	11,976,000	12,186,000
Fixed Assets Intangible	9,192,000	8,952,000	8,952,000
Total	$41,053,000	$50,342,000	$46,350,000
Liabilities			
Current Liabilities	$6,610,000	$11,190,000	$4,993,000
Long-term Liabilities	2,385,000	70,000	5,028,000
Total Liabilities	$8,995,000	$11,260,000	$10,021,000
Minority Interest	117,000	1,000	
Preferred Stock	18,911,000	17,500,000	17,500,000
Common Stock	9,192,000	8,952,000	8,952,000
Reserves	870,000	4,010,000	3,861,000
Surplus	2,965,000	8,619,000	6,016,000
Total	$41,053,000	$50,342,000	$46,350,000
Net Working Capital	$15,893,000	$17,113,000	$18,656,000
Ratio	3.40	2.51	4.74

EARNINGS, DIVIDENDS AND SURPLUS OF A REPRESENTATIVE INDUSTRIAL COMPANY

YEAR	EARNINGS	DIVIDENDS	SURPLUS
1914	$1,113,000	$1,324,000	$*211,000*
1915	2,012,000	1,324,000	688,000
1916	2,462,000	1,324,000	1,138,000
1917	2,442,000	1,259,000	1,183,000
1918	3,503,000	1,225,000	2,278,000
1919	3,278,000	1,225,000	2,053,000
1920	2,892,000	1,225,000	1,667,000
1921	*1,526,000*	1,225,000	*2,751,000*
Totals	$16,176,000	$10,131,000	$6,045,000

* Italic figures indicate deficit.

Consider first the period from October 31, 1913, to October 31, 1920, during which no permanent financing was done. From the foregoing figures the following facts are apparent:

New funds came into the business from:		
Profits, as indicated	$14,886,000	
Unexpended reserves created out of earnings	2,815,000	
Earnings used in reduction of good-will	240,000	
Making a total of new funds realized out of earnings		$17,941,000
These new funds were disposed of as follows:		
Additions and betterments to plant	$2,618,000	
Increased deferred charges	386,000	
Added investments in securities, etc	726,000	
Minority stockholders' interest bought	116,000	
Long-term bonds paid off	2,315,000	
Capital stock retired	1,653,000	
Dividends paid	8,906,000	
Making total expenditures, all out of working capital funds, amounting to		$16,722,000
Which leaves in working capital at the end of the 7-year period, out of the total earnings above, only		$1,219,000

In other words, while the Surplus account of the company increased

from .....$2,965,000 in 1913
to ..... 8,619,000 in 1920

or a total of.....$5,654,000

only $1,219,000 remains unexpended for some fixed purpose. Whatever the free surplus may have been in 1913, it cannot be considered to have increased more than $1,219,000 during that 7-year period.

Noting the expansion in the working capital requirements of the period in question, the propriety of considering even this small increase in surplus as real free surplus is doubtful, for the working capital ratio at 1920 was $2.51 as compared to $3.40 in 1913.

As indicated by the balance sheet, $5,000,000 of long-term bonds were issued during 1921. These partly replenish the working capital for the withdrawals of previous years. Taking the *8 years ended October 31, 1921*, the showing would be as follows:

New funds coming into the business:		
Increased long-term borrowing	$2,643,000	
Earnings including unexpended reserves and good-will written off	16,415,000	
Making a total of new funds received, of		$19,058,000
These were disposed of as follows.		
Additions and betterments to plant and equipment	$2,828,000	
Increase in deferred charges	679,000	
Investments in securities, etc	884,000	
Paid for minority stockholders interests	117,000	
Expended in retirement of capital stock	1,655,000	
Dividends paid	10,131,000	
Making a total of fixed investments or permanent expenditures of		$16,294,000
Which leaves on hand in working capital out of the total received above, only		$2,764,000

During the period of 8 years the Surplus account increased

from .....$2,965,000 in 1913
to ..... 6,016,000 in 1921

a total increase of.....$3,051,000

Of this increase not more than $2,764,000 could be considered free surplus, even if it is assumed that the proceeds of the bond issue were available for any special purpose, which might not have been the case.

While this example has been worked out in a statistical way, by analysis of the reports, a similar analysis may readily be worked out in the ledger accounts of the company, and would have the advantages of continuity and permanence.

Carrying Analyzed Surplus Accounts in the Books

The analysis of surplus and determination of the present form of surplus earnings left in the business may be accomplished in a statistical way from study of the financial reports of a company. But, better than a statistical analysis of the surplus, is an actual analysis worked out in the books and records. This requires the setting up of appropriated surplus accounts and the actual appropriation of surplus for all expenditures which mean permanent investment of earnings left in the business.

The procedure required to set up the analysis of surplus in the ledger accounts of a company is very simple. The steps may be outlined briefly:

1. Provide a free Surplus account to which all net earnings are passed, and from which cash dividends are paid and appropriations made.
2. For all expenditures out of working capital in the way of permanent investments which are not spe-

cifically financed, appropriate a like amount of surplus, setting the sum up as appropriated or invested surplus. Usually annual appropriations will be found sufficient.

3. If additional permanent financing is done, such as long-term bonds or stock issues, and funds are thus made available for general use, the working capital may be considered as being replenished. Or stated otherwise, the permanent investments of the past are now permanently financed, and consequently their amount is released from the appropriated surplus accounts and is again available as free surplus.

While this may appear a pretentious program, it may be carried out readily. And do not the experiences of companies, both past and present, warrant a more thorough consideration—a more searching analysis of their financial position and policies—than is at present customary?

Expenditures Calling for Appropriations of Surplus

The purposes for which appropriations should be made from surplus under the foregoing plan include all expenditures of importance made *out of working capital funds*. These appropriations may be summarized as follows:

1. Expenditures made in retirement of bonds or other long-term debt, customarily covered by sinking fund reserves, which reserves are appropriated surplus.
2. Expenditures made in retirement of outstanding capital stock.
3. Expenditures for additions and betterments to fixed property investments.
4. Expenditures representing permanent investments in other companies, or securities, or long-term advances to other companies.
5. Expenditures covering investments in intangible fixed assets, such as patents, franchises, copyrights, trade-marks, good-will.
6. Expenditures represented by deferred charges, such as organization expenses, development, advertising, etc., where such expenditures are capitalized or carried forward to be spread over a period of years.

It is not intended by this to say that all capital expenditures are to be covered by appropriations from surplus. Obviously that would be impossible. But certainly any *expenditure out of working capital funds*, i. e., not otherwise financed, must be provided for out of earnings, or an impairment of working capital must inevitably result.

Beyond this there are the increasing working capital requirements of a growing company. It would not be inappropriate to set aside surplus to make it sure that the necessary funds for its operations are retained in the business.

Recognition of these principles is apparent in the reports of a few companies which carry a Surplus account and an undivided Profit account. This method may meet the requirements of conservative business policies. However, a more complete analysis of the disposition of earnings, and the form in which those retained in the business are carried, is well worth the little trouble encountered in making it.

Stating Surplus Accounts in the Balance Sheet

The suggestion that the published balance sheet of a company should show clearly defined the free surplus as distinguished from invested or capital surplus, probably would not meet with great enthusiasm. Such an analysis, however, may be made from any well-prepared series of reports. Further, there might be advantages in the analyzed statement, particularly in the case of those companies which have been developed largely out of earnings and which have been able to build up and carry large surplus accounts.

In any event, there should be no objection to showing in the books and private reports of a company the complete analysis of its Surplus account, even though all surplus is grouped for purposes of annual or published reports.

In present practice there is little uniformity in methods of stating surplus accounts in the balance sheets of industrial companies, and too little recognition of the principles which should be observed. A review of the reports of representative industrial corporations as published from time to time will show the wide variety of methods used. In some of these reports, surplus reserves which are appropriated surplus are treated as a part of the net worth, and in other cases are combined with other reserves, which would probably include liability reserves. Bond sinking fund reserves are often combined with reserves for federal taxes or with other liability reserves. Sometimes capital surplus or surplus realized from other than earnings is stated separately; in other cases it is combined with the general or Earned Surplus account. As a general rule few companies make appropriations of surplus to cover earnings expended for permanent investments.

Considerations Affecting Surplus on Balance Sheet

To the layman, or average reader of financial statements, any amount stated in surplus is generally regarded as earnings withheld in the business from which dividends might be paid. Because of this condition it is to be regretted that there is not better recognition of principles in stating surplus accounts in balance sheets. First consideration should be given to the true and proper statement of the net worth of the business, which is the stockholders' equity in it. Thereafter consideration should be given to the proper statement of surplus and whether it represents free surplus retained in the working capital of the business, earned surplus permanently invested in the business, or capital or unearned surplus. A statement so arranged gives a complete and intelligible presentation of conditions instead of the partial and misleading presentment of the usual financial statement. It is obviously preferable.

(To be continued in the June issue.)

Shop Transportation Economics

Westinghouse Methods and Results

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658.281 Shop
transportation

IN the average large plant devoted to the manufacture of diversified products, which involve a variety of materials and operations, it is a safe estimate that from the time the material enters the shop from the storeroom until it goes out in the form of completed apparatus it is actually in process only from 20 to 25 per cent of the time. The other 75 to 80 per cent of the time may be distributed in various ways, but a considerable amount of it must be charged to the handling and transportation of material between operations and departments. The ratio of this time to strictly productive time varies with, and is influenced by, such things as the uniformity, complexity, activity, size, and accuracy of workmanship of the products. In any event, the average figure is sufficiently high to justify the management of most large plants in supporting an activity devoted to the study and supervision of internal transportation.

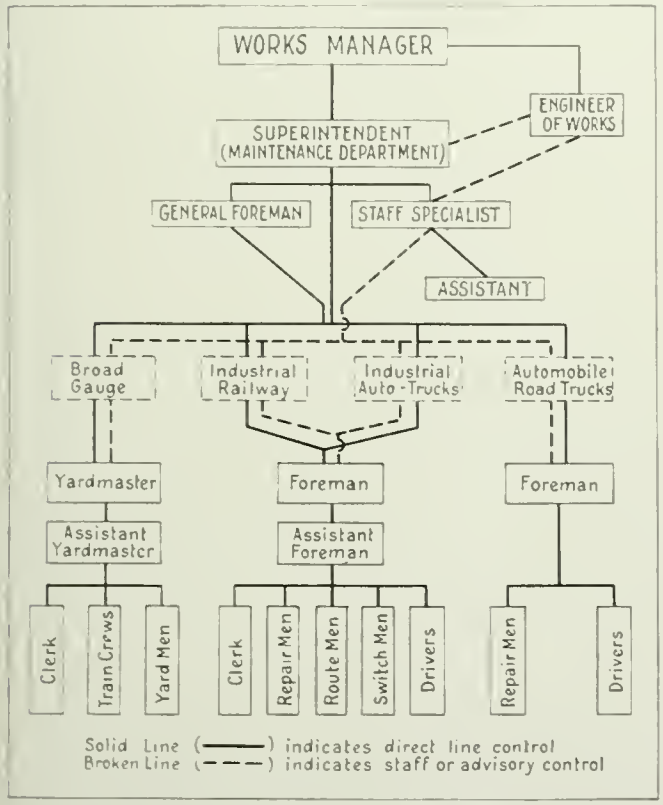


FIG. 1 ORGANIZATION CHART OF TRANSPORTATION ACTIVITIES

In the East Pittsburgh or main works of the Westinghouse Electric and Manufacturing Company, internal transportation comes under the supervision, either directly or indirectly, of the superintendent of maintenance, as may be seen in the organization chart shown in Fig. 1. The line responsibility is carried down, either directly, or through the general foreman, to the foreman in immediate charge of the various phases of the work. A staff specialist, reporting to the superintendent, handles investigations and makes recommendations concerning operating methods and equipment. In general, the work falls into four divisions: broad-gage railroad; narrow-gage or industrial railway; electric battery industrial trucks; and automobile road trucks.

Personnel

The broad gage car movements and yard activities are carried on by a force of about 25 or 30 men including train crews, yardmen, and clerical help, under the immediate supervision of a yardmaster and assistant yardmaster.

The industrial railway and electric battery industrial trucks are combined under the supervision of a foreman and an assistant foreman. This organization includes a force of repairmen, responsible for the electrical and mechanical condition of equipment, clerk, route-men, locomotive and battery truck-drivers, switchmen, yardmen, material handlers and helpers, making a total of about 150 men.

Automobile road trucks are under the supervision of a foreman who has a force of about 12 men including drivers, helpers, and repairmen.

Equipment

More than 100 standard gage railroad cars and 7 steam locomotives are owned and operated by the company. Of the cars, about 80 are used exclusively for yard and interworks service and the remainder are for general road service, carrying Westinghouse products to all parts of the country. The locomotives are used exclusively in and about the East Pittsburgh works.

The narrow-gage railway, commonly referred to as the "industrial railway," serves practically all departments or manufacturing activities on the ground floor, as well as quite a number on upper floors, by means of elevators. The total length of industrial railway trackage is over 8½ miles. The gage being only 21 in., the cars and locomotives are necessarily small and easily handled, making it possible to reach parts of the shop inaccessible with larger equipment.

More than 600 cars are required to give adequate

service. These cars are of two sizes: 6 ft. and 10 ft. long. They have capacities of 3 tons and 5 tons respectively.

Car wheels are flanged on the outside, thus giving maximum stability to the car. Curves are designed on a very short uniform radius of 12 ft., which minimizes the amount of space necessary for aisles.

The locomotives are of the storage battery type and are of the company's own design and construction. They are capable of hauling a train of from 7 to 12 loaded cars. There are a total of 11 such locomotives of which 10 are assigned to regular duties while one is kept in reserve as a spare.

A number of special battery cars similar to the one shown in Fig. 3 have been built to operate on broad-gage tracks. They are used on short hauls or in a particular department where work is handled that is too heavy for the industrial railway but does not justify the use of a standard railroad car.

FIG. 2 A FLEET OF INDUSTRIAL AUTO TRUCKS

Administration and Operating Methods

As is true for many other up-to-date concerns, Westinghouse has found the industrial auto-truck to be one of the most satisfactory carriers in its internal transportation system. It presents a combination of advantages which will be found in no other type of transportation equipment. Capacity for heavy loads; ability to reach otherwise inaccessible places because of flexibility in handling and short turning radius; the elevating platform feature which makes it adaptable to the use of skids and trays; long life, speed, ruggedness and general serviceability—all these things unite to make the industrial auto-truck probably the most efficient shop carrier, when used on work for which it is adapted. A fleet of 73 trucks—some of which are shown in Figs. 2 and 4—of various makes are kept busy at East Pittsburgh. Of this number about half are of the elevating platform type with which skids may be used.

For general road service to and from other places in the city or between the main plant and other outlying subsidiary shops, 8 automobile trucks are employed. There are both gasoline and electric battery trucks of various makes and ranging in capacity from 1 ton to 5 tons used in this sort of work.

Requests for empty cars or instructions to pull cars on the broad gage are directed to the yardmaster who is responsible for their execution.

Industrial railway cars are delivered to any department upon request. Normally, however, the demands of each department are anticipated by the transportation department so that the actual request is seldom necessary except to take care of unusual activity such as overtime work or other special cases.

Cars are numbered serially so that a check of car movements may be maintained with a view to keeping idle time of cars at a minimum.

Definite routes, each covering a specific territory, have been established and a locomotive assigned to each. Loaded cars are classified according to destination and made up into trains in what is known as the Classification Shed which houses a number of parallel spur tracks each of which is reserved for the accumulation of cars consigned to its particular territory. Four locomotives are used to do this classification work, all yard shifting, disposition of carloads of scrap, and all other miscellaneous deliveries not under the jurisdiction of one of the regular routes. Fig. 5 illustrates a

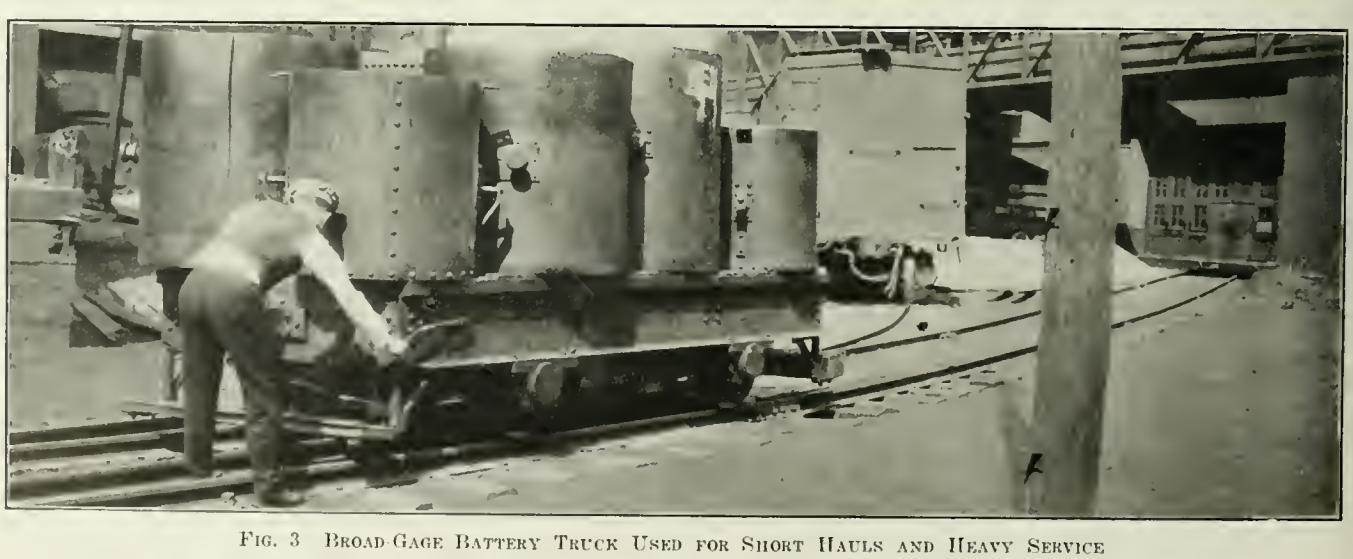


FIG. 3 BROAD-GAGE BATTERY TRUCK USED FOR SHORT HAULS AND HEAVY SERVICE

FIG. 4 CLOSE-UP OF LOADED INDUSTRIAL TRUCK

typical train of industrial cars headed by its locomotive.

The Classification Shed is in reality a terminal or clearing house for all routes. The procedure is for a locomotive to take its train of loaded cars, dropping each off at its proper delivery point, as indicated on a red transfer tag, illustrated in Fig. 6, which is attached to the car by the department loading the material. The locomotive also picks up all empty cars unloaded since the last trip, and all cars loaded by any department on its route which are consigned to a department on some other route. These, with the surplus empties, are hauled back to the classification shed and distributed to the proper tracks as designated by transfer tags. The locomotive is then ready to start out over its route again taking the train which has been made up for it during its absence. In this way each locomotive is able to cover its route from six to eight times each day.

It has been previously stated that the industrial battery trucks are under the same supervision as the industrial railway. This is true in regard to operation, maintenance, and upkeep of trucks. The actual direction of truck movements, however, in the majority of cases, is a responsibility of the supervisory forces in the respective departments to which the trucks are assigned. In such cases the individual departments use the trucks as is most advantageous to their own purposes. For instance, the storeroom department has a fleet of 13 trucks, which they use to make deliveries to all parts of the works. Likewise, the shipping department uses 8 trucks in collecting from all parts of the shop completed apparatus ready for shipment. A group of 5 trucks is reserved by the transportation department for miscellaneous general utility service and special jobs and used according to the discretion of the foreman in charge in complying with telephone requests. All maintenance, upkeep, and repair work on storage battery trucks, and industrial railway locomotives and cars, as well as battery charging, is centralized under the supervision of the foreman of this department.

Automobile road trucks are used wherever needed. Work is assigned and scheduled by the foreman in charge. One truck operates on schedule over a definite route, handling material between the main works and three of the company's outlying shops in the vicinity.

Auto-Truck Versus Hand-Truck

A number of things should be considered before investing in an auto-truck to replace hand-trucks. On many jobs the advantages of the auto-truck are obvious. On other work the advantages are not so apparent, and conditions are frequently found where the auto-truck would be less satisfactory than the hand-truck. Where the volume of work handled is sufficient to keep the auto-truck employed for a large percentage of the time, at or near its capacity, on com-

FIG. 5 INDUSTRIAL RAILWAY LOCOMOTIVE WITH TRAIN

paratively long hauls, and loaded in both directions, we are approaching the ideal and ultimate in transportation efficiency and economy. However, on short hauls, with small loads, as is often true with local transportation within a department, the hand-truck is frequently more satisfactory than the auto-truck. It is better sometimes to use hand-trucks for hauling fragile and expensive material or apparatus. The fact that an auto-truck excels a hand-truck in speed and ability to carry large loads with a minimum of labor, is not alone sufficient to justify its purchase. Each request for an auto-truck is judged on its own merits. The conditions under which it is proposed to operate and the difference in cost of the existing and suggested methods are thoroughly analyzed, and action is influenced by the results.

FIG. 6 INTERNAL TRANSPORTATION TRANSFER TAG

Method of Report

In order to illustrate the method of determining and comparing costs, an abstract from a report on such an analysis is given in the following paragraphs. By means of such an analysis the management is assured, before spending any money, that there is a real need for the new equipment and that its purchase and use will permit added economies in the handling of material in the plant. It will be observed that the various foremen estimate the time now being used for hand-trucking and also the time motor equipment would require for the same work. Figures based on time study would permit closer estimates of savings.

The various foremen having the bulk of the trucking in the department were interviewed with a view to determine what work that is now being done by hand-truckers could be done by an auto-truck, if available, and approximately how much time would be required for the auto-truck to do it. The details follow:

Foreman	*Could release from hand-trucking if auto-truck were available.*	*Estimated time auto-truck would require to do same amount of work.*
No. 1	Full time of 3 men	1/2 day
No. 2	1/3 time of 1 man	1/18 day
No. 3	Full time of 2 men	1/3 day
No. 4	1/4 time of 1 man	1/24 day
No. 5	1/4 time of 1 man	1/24 day
No. 6	Full time of 3 men	1/2 day
Total (Equivalent to)	Full time of 8 10/12 men	1 17/36 days
(say)	Full time of 9 men	1 1/2 days

Thus practically the equivalent of 9 men's time could be released from hand-trucking if auto-trucking facilities were unlimited. Carrying out the above ratio, shown as totals, the work of 9 hand-truckers could be done by one auto-truck in 1½ days, or one truck would replace six men on hand-trucking.

COMPARISON OF COSTS PER MONTH

Present Monthly Cost of Hand-Trucking (Excluding Overhead and Maintenance)		*Estimated Monthly Cost to operate elevating platform auto-truck (Excluding Overhead)*	
Wages		*Wages*	
(6 hand-truckers—assuming only one man to a truck)	$449.28	(1 driver)	$91.52
Note:—Interest, depreciation, upkeep, and repairs on hand-trucks being negligible, they were disregarded.		Interest on investment (Based on Purchase price of truck)	9.33
		Depreciation (Based on 10 yr. life)	15.58
		Upkeep and repairs (From records of past experience)	23.72
		Power charge (Current necessary for keeping battery charged)	8.23
		Total cost	$148.38
		Approximate Monthly Saving	300.90
Total cost	$449.28		$449.28

Based on figures shown above, which indicate a possible saving of $300.90 a month, it is recommended that an auto-truck of the elevating platform type be purchased for use on the work as described in this report.

Automobile Road Trucks

In selecting a motor-truck it is generally necessary to answer two questions, namely:

1. Shall it be a gasoline truck or an electric?
2. What capacity of truck will be the most economical?

Serious consideration should also, of course, be given to the particular make of truck which will be purchased. However, this point is determined largely by price and personal knowledge or experience, based on past performance or reputation of the machines under consideration.

To answer the first question, it is necessary to consider the desired radius of activity. An electric battery truck is very satisfactory when operating over comparatively level ground and where it is not necessary for it to get far from its charging station. Under these conditions it is much cheaper to operate than a corresponding gasoline truck. Furthermore, the maintenance on an electric truck is generally less on account of there being fewer parts to get out of order. Statistics show that their active length of life averages longer than that of the gasoline truck. The cost of power is an important factor. For a company that generates its own current for charging the battery, as does the Westinghouse Company, electric power is considerably cheaper than power from gasoline fuel.

Against all these advantages for the electric truck must be set its limited radius of operation and the possibility of its getting stranded away from its charging station if subjected to more than the usual demands such as heavy grades or longer trips.

The second question, regarding the capacity of the truck, involves such things as the kind and quantity of material to be handled. Obviously it would be better and cheaper to operate one 5-ton truck instead of 5 one-ton trucks if the material were heavy and compact and handled in sufficient quantities to guarantee full loads. On the other hand, the small truck is generally better adapted to work requiring many stops to pick up or distribute loads of a light miscellaneous character.

A comparative analysis of the annual operating costs for two gasoline trucks of 1-ton and 2-ton capacity, respectively, detailing the factors which influence these costs, is given in Table 1.

TABLE 1. ANNUAL OPERATING COSTS FOR ROAD TRUCKS

	1-Ton Truck	2-Ton Truck
Depreciation The life of each truck is estimated at 5 years. Thus, we get an annual depreciation charge of 20 per cent based on initial cost of		
$800 for 1-ton truck	$160	
$3500 for 2-ton truck		$700
Interest on Investment The original investment being reduced 20 per cent annually by depreciation charge, the average investment over the 5-year period becomes one-half the original figure. A uniform annual charge of 3 per cent on the original cost is used rather than 6 per cent being taken on the remainder after each successive reduction in investment	24	105
Insurance The figures given are East Pittsburgh rates for coverage under regular blanket policy. Rates vary with state and city-zone location	29.69	35.88
Rent (Garage) Estimated at $10 per month	120	120
License Pennsylvania State Highway Department Registration Fees for 1924	18.75	70
Wages This provides for one man—the driver	1372.80	1372.80
Gasoline Consumption These figures are based on 1923 records as follows		
1-ton—1691 gal. at 21 cents	355.11	
2-ton—2901 gal. at 21 cents		609.21
Oil Consumption (1923 Figures)		
1-ton—68 gal. at 45 cents	30.60	
2-ton—139 gal. at 45 cents		62.55
Washing Cars are washed on an average of twice a week. The 2-ton truck requires slightly more time for washing than the 1-ton	119.60	143.52
Tires (1-ton Truck) The 1-ton truck uses pneumatic tires in front which will average 6600 miles service. Based on 1923 mileage new tires are required every 6 months, making 4 a year at $17 each	68	
Solid tires are used on the rear wheels. They will give about 20,000 miles service, which means 2 new tires every 18 months. They cost $30 each	40	
(2-ton Truck) Solid tires are used on all four wheels. Front tires are $34 each and require replacement every 18 months	...	45.34
A special make of rear tires at $100 each is estimated to last two years	...	100
Relining Brakes Once a month at $2.50 for the 1-ton truck	30	
Once every 6 months at $1.00 for the 2-ton truck		8
Miscellaneous Upkeep and Repairs 1-ton truck $10 a month	120	
2-ton truck $20 a month		240
Total annual cost	$2488.55	$3612.30

The total annual cost divided by total annual mileage, secured from 1923 records, gives operating costs per mile as in Table 2.

TABLE 2. SHOWS OPERATING COSTS PER MILE

Truck	Total Annual Operating Cost	Total Annual Mileage (1923)	Operating Cost per Mile
1-ton truck	$2488.55	12,704	$0.196
2-ton truck	3612.30	11,901	0.303

The above figures indicate that the actual money spent per mile on the 2-ton truck was about 50 per cent higher than the amount spent on the 1-ton truck. These two trucks, however, are not comparable units of transportation on account of their difference in capacities. The fundamental function of a truck is to transport safely a maximum amount of material as quickly as possible and at a minimum cost per unit. The thing of real importance is not the cost per truck-mile, as given above, but it is the cost per ton-mile. Assuming that the actual tonnages handled by each truck were approximately in the same ratio as their respective capacities, the 2-ton truck becomes the more economical. The cost per ton-mile on the 2-ton truck, instead of being 50 per cent greater, becomes 25 per cent less than that on the 1-ton truck. Hence, large trucks should be used wherever the volume of work justifies it.

Industrial Railway Efficiency

In the strictly technical sense of the word, "efficiency" means the ratio of output to input. It is realized that this meaning is not implied as the word is used in this article, although its use here does comply, perhaps, with common usage—or should we say, misusage—of the last few years.

To say that a transportation system is operating at a certain definite percentage of efficiency, has little or no significance unless the basis of calculation is also known. Certain assumptions that are more or less arbitrary must be made in order to establish standards of measurement. Once these standards are established they should form the basis of comparison for all similar studies and investigations in the future. It follows, then, that the greatest practical value of so-called efficiency studies will not be found in the results of one investigation, but rather in comparisons of the results of a number of successive studies or checks which are made at intervals and based upon the same established standards of measurements.

Industrial railway efficiency is measured in two ways. The first is by the ratio of actual loads to possible loads and the second is by the ratios of running time, loading time, and delays to each other.

An observer rides the locomotive and keeps a record of its activity and performance for the whole day. Note is made of all cars hauled, whether loaded or empty, number in each train, where picked up and where delivered. Time of arriving at and departing from each department or section is also recorded. This study is extended over a period of time sufficiently long to insure having average and representative conditions.

From observation of a large number of cases, 7 loaded cars, or 11 empty cars or their equivalent, have been taken as a standard train which is regarded as 100 per cent with respect to load efficiency. "Running time" is taken to mean only the time that the train is in motion between stops. Shifting time and time required to pick up or deliver cars is termed "loading time". "Delays" include all time lost due to waiting for right of way, clearing tracks, derailing of cars, etc.

A recent study showed a load efficiency of 43.3 per cent, which means that the average size of all trains

observed was only slightly over three loaded cars each, or their equivalent. This is not as high as it should be. Time efficiency, however, is more favorable, showing the following distribution of time:

	Per Cent
Running time	56
Loading time	33
Delays	11
	100

Electrical Tests

The casual observer, seeing two or more auto-trucks of different makes or design carrying duplicate loads over the same route and at the same speed, would naturally conclude that they were of equal efficiency. This is not necessarily true, for one truck may be drawing considerably more current from the battery than any of the others. Such a condition more quickly discharges the battery, thus shortening the period during which the truck can give continuous service as well as the overall life of the battery. The first result is generally not a serious condition, for trucks are equipped with batteries of sufficient capacity to give continuous service for a whole day and which can be fully recharged before the next morning. Some inconvenience results when it is desired to do overtime or night work with the trucks. Frequency of battery replacement obviously has a very direct bearing on operating costs. Therefore, the truck which consumes the least electrical energy to accomplish a given amount of work is the more economical to operate.

In order to compare trucks of different make and design, tests are conducted under the direction of the engineering department. For this purpose an oscillograph is used. This is a very sensitive and complicated instrument which makes a photographic record of current and voltage behavior by photographing the reflected oscillations of tiny beams of light controlled by galvanometers which have been connected into the main line from battery to motor. Tests are run under different conditions of load both from running and standing starts.

Table 3 shows a comparison of the results of some tests made recently. Figures are given for only two of the trucks which were tested.

TABLE 3. COMPARISON OF RESULTS OF SOME ELECTRICAL TESTS OF TRUCKS

Load	600 Lb.		2600 Lb.		4140 Lb.	
	Truck No. 1	Truck No. 2	Truck No. 1	Truck No. 2	Truck No. 1	Truck No. 2
Maximum speed in miles per hour	4.96	5.46	4.07	4.54	3.55	4.16
Power consumed in ampere-hr. during a 200 ft. run from a standing start	0.200	0.456	0.305	0.640	0.421	0.790
Power consumed in ampere-hr. during a 200 ft. run from a running start	0.195	0.437	0.300	0.633	0.363	0.755

From the standpoint of power consumption, truck No. 1 shows much better results than truck No. 2, averaging less than half that of the latter. This is partly compensated for by the higher speed, by about 15 per cent, of truck No. 2. Other advantages being equal these figures greatly favor truck No. 1.

Tractor and Trailers Deliver Incoming Materials

Index Number
658.281 Factory trucking

WHEN a manufacturing plant is not located on a railroad siding or water-front property, trucking is a necessary operation in obtaining incoming materials. An illustration of this method of delivery is found at the plant of the Bass-Hueter Paint Company, of San Francisco, which receives oil in tank cars run on a siding at a point about two miles from the factory.

A Fordson tractor, a semi-trailer, and a trailer are used to transport the oil to the plant. The accompanying picture shows how these vehicles are coupled to perform the required service.

The trailer carries a tank of 1250 gals. capacity. On the front of the body there is a gasoline engine driving a rotary oil pump. The pump is used in drawing oil from the tank car and filling the tanks on the trailers. This same pump delivers the oil to the storage tanks at the factory.

The semi-trailer, immediately back of the tractor, holds a 1000-gal. tank, bolted to heavy timbers. This method is employed so that the tank can be removed quickly and without damage when it is desired to use the trailer as a delivery truck to take paint from the factory to the various local distributors. As a matter of fact, this is the work for which it was designed, as is evident from its low construction and the removable uprights along both sides.

The trucking method described here is very flexible, saves purchasing additional equipment, and has given very effective service. Three trips a day are averaged by the tractor with its two trailers, and in this period they handle 6750 gals. of oil, covering a distance of approximately 12 miles during the day.

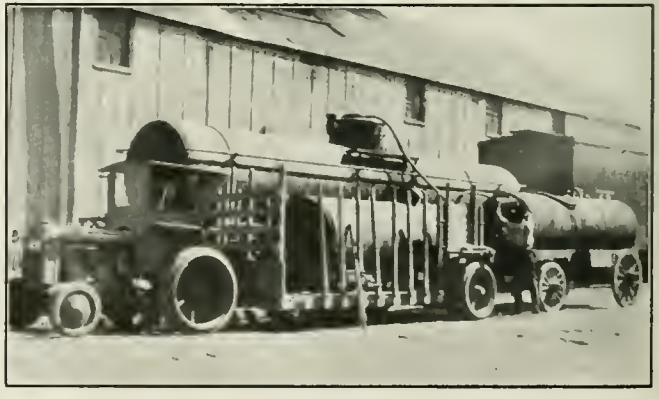


FIG. 1 COMBINATION TRACTOR AND TRAILERS USED FOR HAULING OIL FROM TANK CARS

Conveyors Require Good Management

Mechanical Handling in Cotton Mill Improved Production, Increased Wages, Lowered Costs, and Lessened Labor Troubles

By ROBERT T. KENT

Mechanical Engineer

Index Number
658.281:677 Mechanical handling. Textile mills
658.9:677 Textile mill management

IN the April issue [1] the conveyor system of the Jackson Mills, at Nashua, New Hampshire, was described. The conveyor handles the materials of production from the raw cotton to the finished cloth. Regarded simply as a machine, it is a marvelous piece of work. As an example of engineering it is an outstanding achievement—one that is destined to effect a revolution in the textile industry. This conveyor has done more than move material from operation to operation with fewer men and lower expense than ever before. That is the purpose of its design. But as a by-product, wholly unlooked for, has come a result that dwarfs and makes insignificant this purpose. This by-product is the substitution of science for tradition and rule-of-thumb in the textile industry.

The big achievement of the conveyor is that, by its inherent characteristics, it has reached into the very processes of the mill and compelled the development of every phase of the science of management to a high degree. To the credit of the conveyor may be set these positive accomplishments:

1. A change in methods, far in advance of previous practice.
2. A new way of handling labor.
3. More and better quality goods from the same equipment.
4. A lower operating cost.
5. Better trained, better paid, and better satisfied labor.

Of these, the last is perhaps the most important of all.

As a general corollary to these results, it may be stated that the conveyor system will put the plant employing it in an impregnable position. The following is an incontrovertible fact, too often proved to need any defence: When an organization develops the science of management as applied to the industry of which it is a part, that organization stands head and shoulders above its competitors. The latter cannot approach it in quality of product, compensation to employees, cost of operation, freedom from labor trouble, and profits to owners.

The Principles of Good Management

What are the principles of management? How do they apply to the textile industry? How did the conveyor system operate to apply them? These are pertinent questions that we will examine at some length.

No higher authority than Taylor [2] can be quoted for a statement of the principles of management. He sums them up as follows:

1. The development of a true science.
2. Scientific selection of the workmen.
3. Scientific education and development of the workmen.
4. Intimate friendly co-operation between the management and the men.

Science is defined as systematized knowledge of any one department of mind or matter; acknowledged truth or laws, especially as demonstrated by induction, experiment, or observation. In management, it may be summarized as systematized knowledge of the best way of doing work, not only for the industry as a whole, but for each individual operation in the industry. This knowledge is obtained largely by experiment and observation. It involves the problems of manipulating the materials used, and also the establishment of conditions surrounding their use, including the machinery required that will insure the delivery of the largest amount of *perfect* product in a given time. It involves, also, the problem of having on hand at the place and at the time they are needed, all the materials, tools, and equipment necessary to attain the standard set.

The Development of the Science

Wherein did the conveyor serve as an instrument for the acquiring of this systematized knowledge? In general, by delivering, to the successive operations of the mill, material in such quantities and at such definite intervals that the equipment and the operators of the equipment had to be so organized as to dispose of it as rapidly as it was delivered. Under the usual system of textile mill operation, the slowest machine sets the pace for the mill. The slowest machine is brought into step with the conveyor, which is the pacemaker for all.

How is this slowest machine, or any other machine, brought into step with the conveyor? First, by observation, to determine all the causes of delay on the machine which tend to decrease its output. Second, by observation to determine defects in material, defects

[1] See MANAGEMENT AND ADMINISTRATION, April 1924, p. 411.

[2] "The Principles of Scientific Management," by Frederick W. Taylor, p. 130.

in the machine itself, or conditions outside of these two which prevent the machine being operated at a speed higher than the accepted speed in the industry. Third, by experiment to discover the best methods of correcting the conditions so determined. Fourth, by training the workers to operate the machines to the best advantage after all the causes of delay and low speed have been corrected or removed.

Scientific Analysis of the Spinning-Room

The spinning-room of the Jackson Mills is a good example of the working out of the foregoing procedure. It will be recalled that the conveyor transformed the movement of material throughout the mill from a series of individual movements to a continuous process. A continuous flow of materials entails other problems than simple movement. Material must be moved from the delivery points practically immediately upon its arrival. Otherwise, congestion at one point may back up along the whole system and eventually bring the entire plant to a standstill. Storage stations at strategic points will overcome temporary delays, but the space that can be allotted to these is limited. The supply stations in both the spinning-room and the weave-room of the Jackson Mills are typical of such storage points. Obviously, however, these cannot be made large enough to take the entire output of the roving machines for several hours at a time. The only other solution is so to organize the work that the material will be put in process as rapidly as it is delivered at the terminal points.

The usual conditions of operation call for the spinning-frame operator doffing her own machine. The operators of adjacent machines assist as opportunity offers. This scheme has several defects. The operators are not trained to be highly expert at doffing. Hence the time required for doffing may vary widely. The number of girls that doff a machine is not necessarily the same each time. Therefore, no standard of performance can be set. More serious than these, however, may be the loss of production from other machines than the one being doffed. The operator of one spinning frame assisting the operator of another may fail to notice immediately the breakage of a strand which shuts down her own frame. An appreciable interval may elapse before the stoppage is observed and the breakage repaired. Thus two or three frames may be shut down at one time. Under such conditions, moreover, there can be no attempt made to control production by scheduling the frames so that adjacent ones will require doffing at different periods. It is easily possible for a number of machines adjacent to one another to run out at the same time. The operators then cannot assist each other, and the time for doffing is unduly extended.

It is apparent that the application of a few of the cardinal principles of good management will effect considerable change in the foregoing conditions. These principles are:

1. Scheduling of production.
2. Division and specialization of labor.
3. Laying down of definite tasks.

In the application of the first principle, a definite schedule was arranged so that the various spinning frames ran out of work and required doffing in regular order. The schedule provided that no two frames in the same group would be down at the same time. This accomplished, the application of the second principle became easy.

The division of labor indicated in the spinning-room fell into three groups.

(*a*) Attendance on the frames.
(*b*) Doffing and reloading the frames.
(*c*) Movement of the filled and used bobbins from and to the conveyor.

An operator who has no doffing to do, either on her own or any other frame, can give her entire attention to the operation of that frame. Breakage of strands can be repaired almost instantly, and the idle time of the frame from that cause practically eliminated. The principal cause of loss of production is thus automatically reduced to a very low figure. A special doffing crew is thus indicated as necessary to make possible the individual attention of the spinner to her work.

The doffing crew consists of three girls, trained so that they are highly expert. This crew doffs and reloads all the frames in a given group. Each girl handles one-third of the machine. The time required per machine is in the neighborhood of 1¾ min., as compared to a former time ranging from 5 to 15 min. The boxes of roving are brought to each machine, in advance of its running out, by another worker, and the doffers are concerned only with the removal of the empty bobbins and their replacement. They move from machine to machine in accordance with the schedule, and begin work instantly when the work runs out. This schedule is so arranged that there is sufficient rest period for the doffers to overcome fatigue after they have completed the round of a group of machines.

Task-Setting

The setting of definite tasks for each worker was not a simple matter. In part, it depended on the schedule laid down for the spinning-frames, which in turn depended on some of the factors entering into the setting of tasks. Each of these considerations modifies the other, and no little adjusting and experimenting is necessary before the proper balance is obtained. After all the factors causing machine idleness have been determined and corrected or minimized, the task may be set for the spinning-frame operator on the basis of maximum possible production plus an adequate percentage for unavoidable delay. This then determines the scheduling of the machine, which in turn fixes the task for the doffers. The task fixed for the doffers then governs the conditions for task-setting for the movement of roving from the conveyor to the spinning-frames.

It is quite evident that task-setting for continuous production is no simple matter. Determination of the minimum of unavoidable delays on the spinning-frames involved time studies to ascertain standards for operation, and studies of causes of delay inherent in the

machine and in the material. Doffing standards could only be set by time studies and by experiment to ascertain the length of rest periods and the economical number of machines in a group to be handled by one doffing crew. Elaborate study is necessary to determine the number of men necessary to move material. In this connection an interesting incident occurred at the Jackson Mills, as will be related later, which illustrates the broad-gage spirit which must be behind every movement to increase production if permanent success is to be secured.

Investigating Machines and Materials

A word or two regarding the importance of investigating machines and material, as well as labor, in the setting of standards of performance may not be out of place. The spinning-frame, as a machine, has apparently reached a high degree of perfection. No radical change has been made in it for years and apparently mechanical troubles seldom cause a shut-down. Nevertheless, in the average mill it may have a fairly high proportion of idle time, due to the breakage of strands. The scientific method of investigation, such as was applied in the case at hand, seeks out the underlying causes of delays and removes them. Breakage of strands may be due to defects in the material, inherent in it, or due to defects introduced in previous processes. In either case the investigation may have to be carried back through the roving machines, the cards, the openers, and perhaps into the bales of raw cotton. Correction of defects thus revealed at any place along the line may finally show up in a higher production from the spinning frames.

Then, too, external atmospheric conditions must be considered. The humidity of the air exercises an important effect on breakage. While humidifiers are no new thing in cotton mills, nevertheless many careful experiments were necessary before exactly the correct conditions for each grade of cotton were discovered.

From the mechanical end, certain possibilities may be pointed out. The spinning-frame operates at such high speed that it is impossible for the eye to follow it and to determine exactly what does happen in its operation. It has been commonly assumed that breakage is due to the material, and that the machine is so mechanically perfect as to preclude it as a cause. This is only an assumption, and no one actually *knew*. As a matter of fact, there has been developed in the woolen industry in England during the past year a machine [3] which permits an investigator to see what is taking place at every instant in the spinning-frame. The first use of this machine showed that instead of the bobbins of roving and spun yarn being in synchronism as it has always been supposed that they are, they were continuously varying in speed in relation to each other. The yarn being spun, instead of being under constant tension, would alternately be loose and whip, or stretch. Either is sufficient to cause breakage. It is entirely probable that the use of this device in connection with cotton spinning would reveal many things that should be changed that are now taken for granted as correct. The point that is made here is that in a truly scientific study of any problem exact knowledge of facts must be obtained before any conclusions of value can be drawn.

[3] Described in *Engineering*, September 30, 1923.

Tasks in a Continuous Process

With this digression we may now resume the study of the Jackson Mills. It has been shown that in order to dispose of material as fast as the conveyor delivered it, it was necessary to apply the first principle of management, i. e., to develop the science underlying the work. In developing this science it was necessary to apply several other subordinate principles. The final result was the setting up of standards of performance that put the entire process, from start to finish, in balance, with a greatly increased output and lower costs. Emphasis should be put on the fact that the application of the last of the subordinate principles mentioned—task-setting—was not task-setting in the ordinary sense that it is understood in the machine shop or other discontinuous work. In fact, the author doubts whether the word "task," or any other word of similar meaning, was ever used at the Jackson Mills.

Nevertheless, in the management sense, tasks were set, just as certainly as they have been set in any industry. If for task, the words "predetermined quantity of product" be substituted, the analogy will be clear. The speed of the conveyor determined the quantity of product that would be made in a given time. The development of the underlying science fixed the conditions of material and machines to produce this predetermined output, and the job of the operators was to keep their machines running. Having done this, the "predetermined output" would be achieved and the "task" automatically accomplished.

It is unnecessary to pursue here the development of the science in the other departments of the mill. The same process was followed of observation, investigation, and experiment, to bring the warping in step with the spinning, and the weaving in step with both the warping and spinning. From end to end of the mill, the conveyor was a potent influence for the searching out of every cause of machine delay and lost output. We may now, with profit, briefly examine the application of the three fundamental principles of management that we have not yet considered, and find out wherein the conveyor caused their application.

Scientific Selection of the Workers

What does scientific selection of the workers involve? It involves, first, the determination of the qualities necessary in the worker to perform the task without undue fatigue; second, the selection of workers possessing those qualities. To confine ourselves again to the spinning-room, what are the qualities required of spinning-frame operators? First, alertness, which will enable them to react quickly to the stoppage of the machine; second, quickness of eye, to enable them instantly to detect the broken strand causing the stoppage; third, deftness, to enable them quickly to pick up and tie the broken ends and restart the machine; fourth, robustness, to enable them to remain on their feet and

move around the frame for long periods of time if necessary.

The qualities needed for the doffing crew girls are much the same. In fact, spinning-frame attendants are developed from the doffing crew. In the Jackson Mills, due to the relatively high speed of production, the need of these qualities is accentuated. A girl lacking in any of them would cause her machine to fall behind schedule and throw production out of balance.

Having determined the qualities, a few simple tests will show whether or not a girl is fitted for the job without actually trying her out on the machine. It is probable that some of the methods of the psychological laboratory could be used to advantage in this connection. That the Jackson Mills has scientifically selected its workers is proved by the fact that the machines do keep to their scheduled performances, and that the operators are not particularly fatigued at the end of the day. Stress should be laid on this last point. If the work results in excessive fatigue, one of two things is indicated. Either the job is too big or the worker is unfitted for it. It cannot be too strongly emphasized that good management will not set a task that the worker cannot perform day in and day out and thrive under. And now may be related the incident referred to above in connection with the setting of a task for moving the roving from the conveyor to the spinning-frames.

The Application of Common Sense

Time study was used to determine the number of men required to supply the doffing crews in a given room with roving. The time-study man reported that one man could do this work. The mill manager decided to use two. The time-study man protested, and offered to demonstrate the correctness of his deductions by doing the work himself for three days. His offer being accepted, he actually kept the doffers supplied. At the conclusion of the test the manager reaffirmed his decision to use two men. He pointed out that although the time-study man had demonstrated that one man could do the work, he was so fatigued at the end of the day that he could not make use of his leisure time. Furthermore, the result was accomplished by a man interested in proving his point. The insistence on such a pace for an ordinary workman would be nothing less than cruelty, even were it possible to find men willing to work under such conditions. The expense of the few extra men required would be more than repaid in the contentment of the men with their jobs. Also, the tight schedule required with but one man on the job gave no leeway for contingencies. A slight delay on his part might result in the shutting down of one or more machines. Such delays could easily become cumulative with the result that half the machines in the room might become idle.

The above paragraph illustrates one of the great dangers of time study. Properly made and wisely applied time studies are of the utmost value. Under any other conditions, they may lead to nothing but trouble. It is not sufficient to divide the number of minutes required for *one* job into the number of minutes in the day, and call the result the set task for the day. Every factor involved must be considered, and not the least important is the ability of the human machine to withstand long periods of continued exertion without adequate rest.

Scientific Education and Development of the Worker

The training of the workers follows naturally on the determination of standards of performance. The conveyors set the pace for the machines. The study of the science of handling the machines develops the best methods of operating them and the type of worker best fitted to use these methods. Any great deviation from the methods so found would result in a slowing down of production. Having found suitable operatives, it becomes a simple matter to train them to use the methods found to be the best. This simply means that the overseers not only instruct the workers but insist upon their following instructions. Failure to do so immediately reveals itself in loss of production with a resulting loss of pay. Such a condition tends to correct itself. Persistent failure indicates an unwillingness or an inability to learn, or unfitness for the job. The latter is unlikely, if proper selection of the workmen has been made in the first instance. The former usually results in the worker removing himself from the pay-roll, either under pressure from his associates or by action of the management. With balanced production and high standards of performance such as follow the installation of a conveyor system, a mill cannot operate smoothly without training its help.

At the Jackson Mills it was found that some of the early difficulties with the conveyor were due to the operators attempting to carry on under their accustomed methods, or to improve on those that had been developed as best. For instance, material would be removed from the conveyor direct instead of from a supply station. In a single instance this might do no harm, but as a common practice it would upset the whole room. Only after rigid insistence on the established routine did the conveyor function as it was intended that it should.

Co-operation Between Management and Workers

Co-operation results almost automatically when the first three principles of management have been applied. The duties of both management and workers become clearly defined, and each realizes that the greatest earnings both for labor and capital are possible only when each does his part. In the case at hand the conveyor threw into sharp relief the things that management had to do to obtain production. These lay in the fields of machines and methods, and however obvious they might be, they were beyond the control of the workers. When management had done its part, the things the workers had to do were in equally sharp relief, and to increase their earnings they, too, had to co-operate. The ultimate result has been an esprit de corps that may well be envied, a low cost of production, a satisfied, well-paid body of workers, and a production per worker that is astounding.

In attaining co-operation, the burden, as a rule, is on the management. Innovations in methods of work

are usually resisted by the workers. It has been found in many instances that the resistance is not to the new methods in themselves, but to the change in habits that the new methods require. Once the change is effected it is quite as difficult to persuade the workers to resume their former habits as it was originally to have them abandon them. In fact, the resistance may be even greater in the second case. The right way is usually the easiest way in the long run. When management has, by investigation and study, found the right way of doing a job, the worker discovers that he has been freed of many petty annoyances and useless motions due to defective or insufficient equipment and material, and that he is following an established routine which is always less fatiguing than a job that does not run smoothly. Naturally he will resist any change which will substitute a more tiresome performance. It is obvious that it is management's function to demonstrate to the worker that the new methods are easier than the old. This part of the problem is just as important as developing the new methods. In fact, the job is but half done if the methods are developed, and then not "sold" to the worker. This may be accomplished both by instruction, and by a judicious increase in the earnings of the worker, as a result of his co-operation to secure better production. This latter phase of the question is discussed more fully below.

The Economic Phase

A hard-headed engineer has said that the prime object of a corporation is to make dividends for its stockholders. Hence, the economic side of the question must not be obscured by admiration of the achievement of such a mechanical device as a conveyor in securing a well-trained, contented working force and in developing, almost unconsciously, the principles of management. Desirable as these are, the conveyor had to pay for itself if it were to be considered successful from the economic standpoint. Let us see.

Just how many men engaged in the moving of material were displaced by the conveyor is hard to say. Estimates by various officials range from 19 to 27. These men earned about $1000 per year each. The conveyor as it stands could probably be duplicated for $75,000. At the lowest estimate the savings due to an investment of $75,000 then is $19,000 per year. Against this saving, however, certain charges must be made as follows:

Interest at 6 per cent on $75,000	$4500
Depreciation at 5 per cent	3750
Maintenance at 2 per cent	1500
Labor for maintenance (1 man)	1500
Power (gravity does most of the work)	500
Total annual cost	$11,750

The net saving, then, is $7250 per year, or 93¼ per cent on the investment. If the higher figure of men displaced is taken, the saving is $16,250 per year, or nearly 22 per cent on the investment.

These figures are impressive. They prove beyond question that the conveyor is worth while, even if it did nothing more than move material. But, as we have seen, it did far more than this. The savings resulting from increased production per worker doubtless make the other figures insignificant, but they are far more difficult to ascertain.

Savings Are Proved by Actual Operating Figures

A single instance will suffice. Prior to the installation of the conveyor, one weaver ran 16 looms. The specialization of labor resulting from the conveyor relieved the weaver of some of his former duties and he can now give undivided attention to the looms. He is now able to operate easily 32 looms. While the piece rate per yard of cloth made is lower than before, his earnings are greater due to the increased production. This increased production is due both to the larger number of looms and to the studies that reduced their idle time.

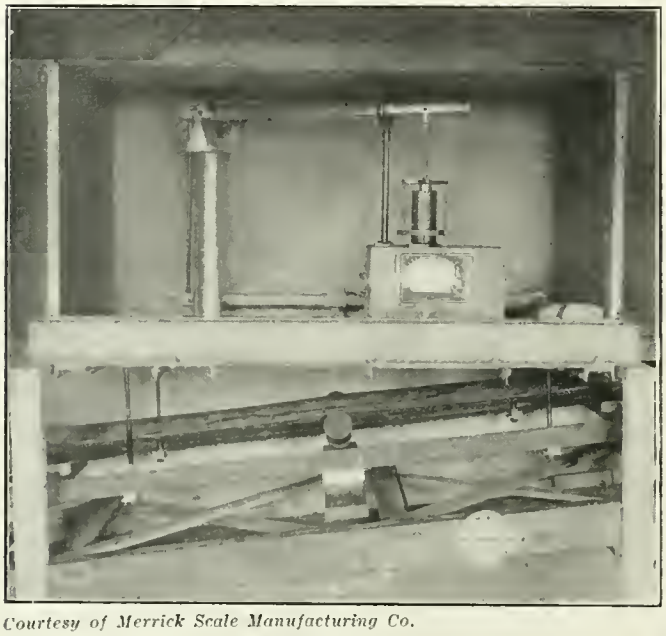
Nor is it unfair to the weaver that his piece rate per yard should now be lower. A portion of the money so saved has been expended in the investigation and correction of conditions beyond his control and which formerly decreased his earnings. Another portion is expended in paying the wages of the workers who have taken over some of his former duties, and without whose co-operation he would be unable to run as many machines as he now does. To accomplish this increased production with the resulting increased wages for the workers required a heavy initial expenditure for the conveyor and for the investigations and necessary changes in equipment. Such expenditures could not have been made were labor to reap the entire gain from increased production. Had they not been made the workers would have remained at their former low scale of wages, and would have continued to work under conditions far less agreeable than they now have. That the workers themselves do not regard the lower rates as unfair is indicated by their willingness to undertake the operation of an even greater number of looms at a still lower rate per yard of cloth. These statements are intended to forestall the arguments of professional uplifters that labor alone is entitled to the whole gain accruing from increased production.

The remarkable thing about these savings is that they are the direct result of a mechanical device, conceived by an engineer to accomplish a definite object, which was quite different from the final result obtained. Looking backward from the finished achievement, it is easy to recognize the fact that the conveyor would reach into every department of the mill and compel the adoption of the fundamental principles of good management throughout. It was not so easy to foresee the radical changes that would follow the adoption of mechanical equipment in place of the time-honored methods of moving material in the textile industry. Now that the soundness of the principles involved has been demonstrated it is inconceivable that the textile industry should continue to ignore the possibilities that the application of mechanical engineering holds for it. The writer's contention that good management must be preceded by good engineering seems to have been substantiated in the textile industry.

Conveyor Weighing in Industry

Index Number
658.281 Conveyors
389 Weighing

INDUSTRIAL plants of all kinds are realizing more and more the importance of keeping an accurate check on their raw as well as finished material. Since it is practically impossible to handle by hand the extremely large quantities of material which are necessary in the modernized plant, conveyors are extensively used, and this, of course, eliminates the old method of hand weighing. The question then arises—How can the weight of the material be determined without seriously interrupting the progress of operations?



Courtesy of Merrick Scale Manufacturing Co.

FIG. 1 CONVEYOR WEIGHING SCALE WITH DUSTPROOF CASING REMOVED

It is a comparatively simple matter to measure the volume of a gas or liquid passing through a pipe. But measuring the weight of bulk material in motion on a conveyor involves entirely different principles; yet by an ingenious system of suspension and gearing, even this has been accomplished. A portion of the conveyor is suspended on a floating platform hung from a load lever system similar to a platform scale. The load on this suspended portion is counterbalanced by a steel float in a mercury bath suspended from the long end of the weighing beam. This float allows the beam to move from its zero position (the position when no material is on the conveyor) in exact proportion to the weight of material on the suspended portion of the conveyor at any given moment. At the same time, by gearing from the conveyor itself, a mechanical integrator transmits this beam motion to the actual weight indicator, in proportion to the speed of travel.

Not only in loading in and out, but in many manufacturing operations this method of weighing eliminates a man at the scale and results in better organization of production processes.

At hundreds of plants, this method is used for billing out material. The Michigan Limestone and Chemical Company, for instance, sell all their stone over conveyors. This plant ships between five and six million tons of stone in about nine months. Here the stone comes from the crushers, is delivered to a system of conveyors, which carry it to bins or outside storage; other conveyors are then used to move the stone to the boats or barges and on each loading conveyor the weight of the stone is mechanically recorded.

In a prominent New England paper mill, not only is the coal weighed as it is received, but during the process of paper manufacture wood chips and sulphite laps are weighed as they are conveyed. Prior to the installation of this method the chips were recorded on a cordage basis, regardless of moisture content and grade of pulp wood, while the laps were weighed by hand with a consequent employment of several weighmen.

Cement mills keep records of material such as hot cement clinker as it comes from the kilns, also stone and shale from cars or storage, and finished cement, by using conveyor scales. These machines have also been adapted to proportioning shale and cement rock.

In many cases cable cars are weighed while in transit over a track scale, thus obtaining the weight of the material without stopping the cars.

A generation ago, the hand-operated scale could easily keep pace with the man and his wheelbarrow. Today industry cannot wait on such slow methods; commodities must move uniformly for greatest efficiency, therefore, extensive use must be made of the conveyor and its complement, the conveyor scale.

Courtesy of Merrick Scale Manufacturing Co.

FIG. 2 WEIGHING SCALE INSTALLATION ON BELT-CONVEYOR

Controlling the Flow of Package Products by Materials Handling Equipment

Assured Savings in the B. T. Babbitt Plant

By JEROME MENDLESON

President, B. T. Babbitt Co.

IN the manufacture of a standard line of products in great quantities, the use of materials handling equipment brings about large reductions in costs. Where the products are packed in small containers for retail distribution, such equipment is necessary in order to keep manufacturing on a dividend-paying basis.

A plant layout which enables direct routing of materials through various operations, from the time they are received in the raw state until they are shipped as finished goods, likewise is desirable, and even imperative, for large-scale production. With these requirements in view, the B. T. Babbitt Company employs labor-saving devices and simplicity of routing in the manufacture of chlorinated lime, caustic soda, cleanser, and powdered, granular, and solid lye, at its plant in Albany.

The plant, employing a total of over 500 workers, comprises two large buildings, one of four stories and one of three, located on a siding of the Delaware and Hudson Railroad. Six box cars of incoming materials are spotted at a time, one at each of the six doors of the two shipping-rooms. See Fig. 1. These materials, and also wooden packing boxes, crate lumber, fiberboard boxes, and other incoming supplies, are unloaded from the cars and moved to suitable storage points within the buildings, after which cases and drums of finished product are run onto the same cars for shipment.

Essential details of the layout of the various floors are given in Figs. 2 and 3. These drawings show only the diagrammatic arrangement of handling procedure and routing of processes. The full number of machines at each point has been omitted for purposes of clearness. Many items not pertinent to the present discussion of materials handling have also been left out. Route lines of the important products, and the course of manufacture of containers in which they go, are indicated. The diagrams are located in the same relative position to each other as that occupied by the two buildings. The building in Fig. 3 is the original one and will be taken up first in the discussion.

Index Number
658.512 Routing
658.281 Materials handling

Manufacture of Lye

Drums of caustic soda weighing, approximately, 700 lb., are rolled down a slight incline from the freight cars, across the room, and over a skid to a drum or barrel elevator, made by the Jeffrey Manufacturing Company, which unloads them automatically on the second floor. Here they are run under a sledging machine, where five hammers drop successively on them, as they are rotated, to break the joints and crush the contents. They are then rolled to Sturtevant open-door type grinding machines at the end of the room. Tops and bottoms are knocked off with an ax and the body opens up so that the material may be shoveled into the hoppers of the machines, located in the floor.

The material is mixed and ground in passing down

FIG. 1 GENERAL VIEW OF THE B. T. BABBITT PLANT SHOWING RAILROAD SIDING

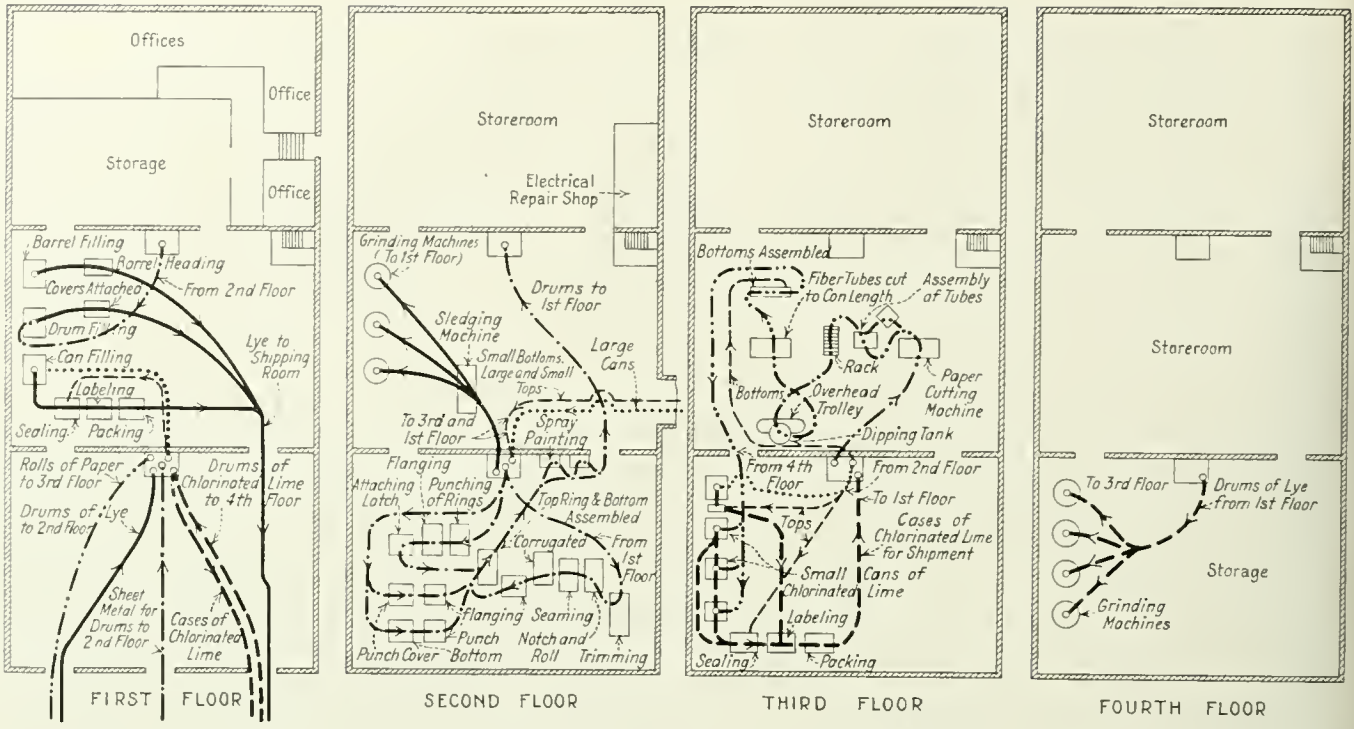


FIG. 2 DIAGRAMMATIC LAYOUT OF FOUR-STORY BUILDING SHOWING ROUTE LINES

to the lower floor, and falls into the hoppers of Blake filling machines. One man feeds the round, topless, empty cans into each of these machines, six at a time, and they are automatically loaded with a definite weight of the caustic, or lye, and fed to a Jeffrey chain-conveyor system. In transit they are split into equal groups and carried to two Max Ams sealing machines. As the cans approach, a man places a combined ring and cover (the manufacture of which will be explained later) on top of each, and the machine fastens them on the cans.

The conveyors then unite the two streams of cans and pass them before an inspector, who removes any that may have defective sealing. They are then carried down a slight incline, receiving a quarter turn to lay them on their sides. In this position they roll through a Burke labeling machine, which pastes the printed labels around the circumference. One girl attends the labeling machine.

From this point the cans roll a short distance to a packing bench, shown in Fig. 4, where two packers load them into wooden or fiber-board boxes holding 48 cans. These shipping boxes are trucked from storage to the packing points, and after being filled, they are put on a short roller-conveyor and delivered to a nailing machine, or, if of fiber-board, are run through a sealer. In one instance the arrangement of the room permits the nailing machine to be located directly in front of the packing bench, thus eliminating the extra conveyors. Assembled covers are laid on the wooden shipping boxes and in two operations are nailed on at both ends. The boxes are then loaded on platform skids and taken on Cowan lift-trucks into the next room, where shipping is done. (Two men work at each nailing and truck-loading point.) From this point the boxes are loaded into box cars by means of trucks.

Goods produced for later shipment are taken by means of freight elevators to upper floors where they are stored at convenient points until needed.

Thus it is seen that caustic soda for this particular kind of preparation comes into the receiving-room, is elevated one story to a second room, is processed in dropping down again one floor to a third room, where it is packed, and then taken by truck back to the point where it originally came in. In the department just described approximately 2100 cases of caustic soda are produced a day, or a total of over 100,000 cans.

Processes in Can-Making

Another major process conducted in this building is that of can manufacture. The cans are made in a room on the second floor, as shown in Fig. 3. Here again the arrangement of processes is designed to eliminate all possible retravel. Automatic machines are used, to a great extent, and they are located so that parts are delivered from each process at a point convenient for moving them to the next operation. In some cases the travel to the next machine is on chutes or rollers. These are of sufficient extent to provide storage when the operator may be forced to break the steady flow of work through the next machine. Automatic counters on all machines register the output and save all the work and errors involved in piece-work calculations.

The methods of handling materials in the making of cans will now be outlined. Sheet iron and tin plate, from the American Sheet and Tin Plate Company, about 20 x 25 in. in size, and packed in small crates, arrive in box cars at the doors of the general receiving-room downstairs. They are trucked to the elevator and taken to storage rooms on the second and third floors.

Figs. 2 and 3 show the storerooms in both buildings.

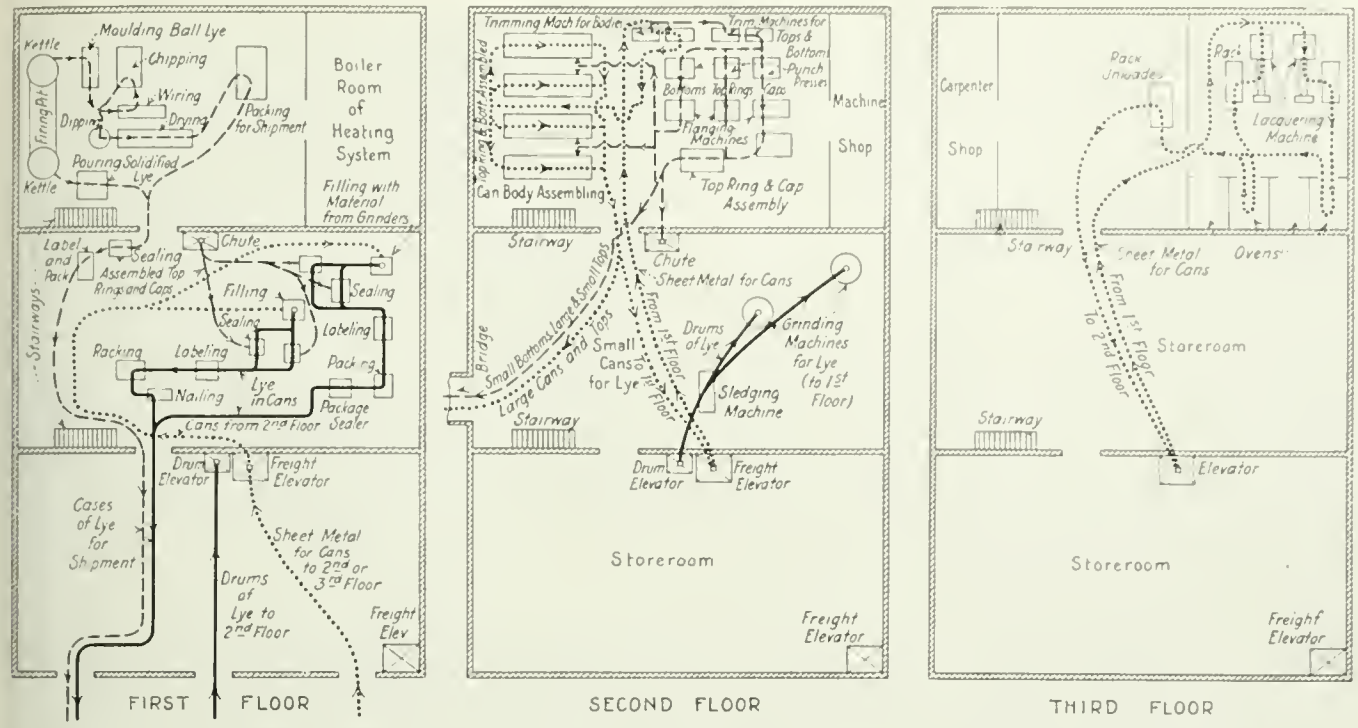


FIG. 3 DIAGRAMMATIC LAYOUT OF THE THREE-STORY BUILDING SHOWING ROUTING OF MATERIALS AND PRODUCTS

The contents of each storeroom are not uniform but represent raw materials, packing containers, metal for cans, finished products, etc., in varying combinations. This plan is necessary in order to distribute the floor load properly. In most cases no extra amount of trucking is involved in this procedure, and free access is always obtainable to any particular stores desired.

The sheet metal is taken from storage to trimming machines in the can-making department. (Some sheets must first be lacquered, as will be explained later). Sheets for can bodies are first trimmed to length and width. The cut sheets are stacked in shallow-sided frames, the waste portion being dropped off into scrap boxes. The next process cuts sheets into from 4 to 8 sections, depending on the size of cans to be made. Trimmers cut about 12,000 bodies per day. The boxes of cut material are then trucked over to the forming machines, many of them now rigged for automatic feed, while some are still hand-fed.

FIG. 4 PACKING-ROOM FOR LYE
Loading Bench in the foreground. Sealers at second post.

The first operation notches the joint and rolls the body. The second folds and fastens the seam. The cans then roll to a third operator who runs them through the flanging machines where the flanges for the bottoms are formed. The fourth operator feeds bottoms into a disc and the machine fastens them to the can bodies as they roll into the machine. Another operator removes the assembled units from the discharge chute and loads them, top side up, into large boxes mounted on a swiveled frame. When one box is filled the frame is swung around and the second is then loaded while the filled box is being replaced by an empty one.

Fig. 5 shows a section of the can-making department. In the foreground assembled units are loaded into boxes. Assembling and forming machines are shown in the background. Each unit is capable of turning out about 35,000 cans of average size per day.

Making of Bottoms and Covers

The method of making bottoms is similar to that for bodies. Sheets are trimmed into strips and are delivered to the presses which stamp out the discs. Adjacent machines flange them. In each case the metal is fed to the machines by hand, and drops into boxes when processed. About 40,000 a day can be turned out by each machine.

Both body- and bottom-making are routed as directly as possible. The course of processes is shown in Fig. 3. One handling, only, is necessary between operations, and even this is done away with in the forming of bodies and assembling with bottoms, where chutes transfer the units between machines.

Covers for boxes are of the familiar ring and cap style, the latter beaded and pressed into the former so that it can be pried off to get at the contents of the can. Rings are punched out on one machine and flanged on a second. About 33,000 a day is the output of one unit. Caps are punched out and stamped with directions for prying off, all in one operation. They are curled or beaded on a second machine. Production averages about 40,000 pieces per day for each machine.

Caps and rings are assembled by machine to form complete lids. By reference to Fig. 3, it will be noted that the process of cover-making is unidirectional, that is, the work proceeds in a straight line from trimming, through punching and flanging or beading to assembly machine. Opposite the latter is a chute. Down this the covers are dumped, falling into a hopper from which they are loaded into boxes on the lower floor. They are then carried over to the sealing machines and assembled on the filled cans of lye, as previously described.

For lye the cans must be coated to protect the metal from corrosion. This lacquering is done on the third floor of the building. The sheets of stock are run through the coating machine onto belts and stacked by hand on special racks. After being baked in ovens, they are taken into the outer room, stacked, counted, and sent by truck to storage or to the can department.

Special Products

A small department on the first floor is devoted to the manufacture of ball lye and solid, concentrated lye. The former is melted and poured into forms into which a wire is dropped. When hardened, the lye balls are removed, chipped, dipped in a preservative, and hung by means of the wires on drying frames, after which they are wrapped in wax paper and boxed. The course of operations is indicated in Fig. 3. This figure also shows the process of making the concentrated lye, which is poured into cans, allowed to harden, and trucked to a section of the adjoining room, where a hand-sealing machine puts on the tops. Labels are pasted on by hand. The volume of these two latter products is not large enough to warrant mechanical methods of processing and handling.

FIG. 5 ONE END OF THE CAN-MAKING DEPARTMENT
The machines shown form the bodies and attach the bottoms.

FIG. 6 THE DRUM DEPARTMENT
The rolling and notching machine is in the foreground.

In the newer building, Fig. 2, of concrete construction, similar methods of handling are used. Products turned out here are lye and caustic soda in barrels, drums, and large cans, and chlorinated lime in large cans and fiber containers. The procedure in handling lime follows closely that of packing lye. The drums, weighing about 700 lb., are unloaded from box cars directly into the receiving-room on the first floor. A freight elevator takes them to the fourth floor, where a sledging machine breaks the joint and crushes the contents. After the drum is opened the material is fed into the grinding machines, the hoppers of which are at floor level.

The lime drops to the third floor where Day filling machines load cans in a manner similar to that followed for lye. The filled cans are run through a sealing machine where covers are fastened on, through a labeling machine which wraps and pastes the labels in place, and thence to a loading table.

The cans are packed usually in fiber-board boxes for eastern shipment, and these cases are sealed by hand. For distant points, or where shipments are subject to much rehandling, wooden boxes are employed, and, in this department, are nailed by hand. Filled cases are trucked to a nearby storeroom or are taken on freight elevators directly to the shipping-room, where the material originally entered. Trucks are used to load cases into box cars for shipment.

Manufacture of Heavy Paper Cans

Another process conducted on the third floor is that of making fiber-board or heavy paper cans. The paper is purchased in large rolls about 27 in. wide. These are received in box cars, and are trucked to the elevator which carries them to the third floor. Here they are stored adjacent to the point of use.

Rolls of paper are placed on a trimming machine which cuts them into 11 narrow strips and rerolls them. These small rolls are taken to a winding machine along-

side the trimmer, where two at a time are run up into a hollow tube to form can bodies. One strip picks up glue in the process, which sticks the paper rolls together. This machine also trims off the waste and cuts the tubes to a definite length.

As they are taken off the winder, the tubes are stowed in racks, and then wheeled to one side of the room where they are loaded, 90 at a time, into a wire cage and dipped in a preservative. A hoist running on an overhead track, looping back upon itself, is used in this process. The tubes are then restacked in the racks to dry.

From this point they are wheeled to the middle of the room again and cut by machine to can length. The operator drops them into a large box which, when full, is moved a few feet over a conveyor. Here they are run through a machine which clamps on the metal bottoms. As they come off of this latter machine they are stacked into large boxes, like those used in the process of making metal cans.

The paper boxes are then trucked to the filling

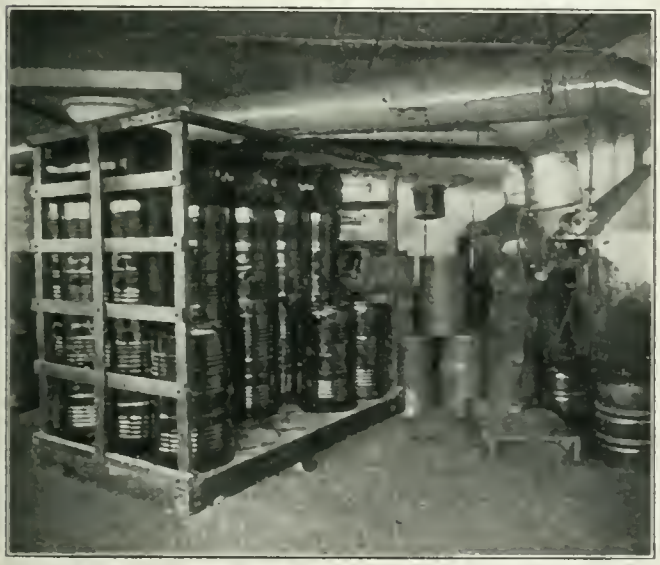


FIG. 7 PAINTING DRUMS BY THE SPRAY METHOD
A special truck is used to transport the drums after assembly.

station in the next room, where they are handled by conveyors as previously described.

Bottoms for these cans are made by the can department on the second floor of the other building, Fig 3. They are trucked over a covered bridge spanning the street on this second floor level (Fig. 1), up the freight elevator directly to the point of use in the paper can room on the third floor. Tops, likewise, follow the same course, except that they go into the filling room and are unloaded at the sealing machine. (See Fig. 2).

Larger-size metal cans for chlorinated lime come, with bottoms assembled, from the can department and are unloaded at the filling machine in the lime department. Tops for these cans follow the same route.

As many of the caustic soda products go to commercial users instead of to the household trade, it is necessary to pack them in larger containers. The plant, therefore, maintains a drum-making department. A general view of this room is shown in Fig. 6.

The operations of drum-making are similar to those for small cans. First of all, the sheet metal is moved from storage to the trimmer where it is cut to size both ways. Scrap is pushed off into a box and trimmed sheets are loaded on a truck. At an adjacent machine they are notched for the joint and rolled. The third machine in line forms and fastens the seam, and the fourth flanges both top and bottom. The next step is to corrugate the circumference of the drums near the top and bottom for the purpose of strength. Finally, bottoms and top rings are assembled on the drums by machine. The bottom is first flanged on and then the drum is inverted and the top ring is attached.

All of these machines are located in sequence of operations down the room. Trucking is necessary only between trimming and rolling. The drums from this point are stood on the floor one by one after each process, within reach of the operator on the next machine. A little storage space is allowed to take care of any piling up of work between successive steps of manufacture.

Bottoms, top rings, and covers are stamped out of sheet metal at the lower end of the drum-making machines. Covers are not held on by press fit, but by means of latches, and the top rings must be punched in four places, to attach the fasteners. It is necessary, therefore, to put the rings through an extra process, that of riveting the latches in place. The riveting machine is included in the direct routing layout of machines for top ring-, cover-, and bottom-making.

Painting of Drums

Assembled cans, without covers, are piled on large special trucks and moved across the room to be coated under a ventilating hood, by means of spray painters. One of the trucks used is shown in Fig. 7. It is mounted directly on wheels, and serves to take the drums either to filling stations or to storage, according to requirements at the time of painting.

The handling of caustic soda to go into large containers is done in the following manner. Drums of the material come from the box cars into the receiving-room on the first floor. They are rolled over to a

FIG. 8 BABBITT PRODUCTS IN ONE OF THE MANY STOREROOMS
Platform skids are used with lift trucks to move material.

freight elevator and delivered to the middle room on the second floor. Here they are sledged by machine, opened, and discharged into grinding machines with hoppers at floor level. The route lines are shown in Fig. 2.

On the first floor are the large filling machines which drop a definite weight of product into barrels, drums, or large cans, according to the orders to be shipped. Barrels are headed by hand after removal from the filling machine. Covers are likewise placed on the drums and latched in this same department.

Loading Products for Shipment

Large cans run to a hand-operated sealing machine on a conveyor, which then carries them to a loading bench. Here they are placed on wooden boxes and nailed by hand. If for export, they are wirebound by a small, hand-operated machine which pulls up, fastens, and cuts the wire.

Barrels, drums, and boxed cans of the caustic soda are then loaded on trucks, usually employing platform skids, and are taken into the next room for shipment, or else to one of the storage points. This material in the course of preparation has been moved up, and then down, one floor, and has entered but three rooms in looping back to the point of shipment. Fig. 2 shows that drum material has also followed a very short route and involved a minimum of handling during manufacture. Cans are made in the other building (Fig. 3) and are trucked over the bridge and down one floor to the filling point. Empty barrels and boxes are received in box cars and sent to storage until needed, but are moved only a short additional distance and require only one rehandling over that involved if they were at once sent to the point of use.

Labels for the various kinds of products and sizes of cans arrive in the same receiving-rooms as other incoming supplies. They are taken to storerooms convenient to points of use, and from there to the automatic- or hand-labeling machines, as needed. Practically nothing comes to the plant by truck, and rarely do outgoing products leave by truck, the only exception being goods for local wholesalers. The company operates no vehicles of the horse-drawn or motor-driven types. The railroad siding forms the almost sole channel by which materials come in and products go out.

It is cheaper to buy most of the shipping containers — fiber-board and wooden boxes, and barrels—than to make them. Crate lumber is bought cut to size, and requires only assembling in the carpenter shop. Not much of the product is shipped in crates, however. All of these containers are stored as near as possible to point of use, but proper distribution of floor load is a factor in placing incoming containers.

Storage of filled drums and cases (See Fig. 8) is likewise governed by the two considerations of convenience to the shipping-room and equitable allotment of weight on the various floors. However, to facilitate handling, most of which is by trucks of the lift type, and to give ready access to all materials in storage, ample aisle space is maintained. Storerooms are kept clean and orderly, and free from useless items at all times.

Mechanical equipment plays a vital part in our handling problems. We have standardized on lift trucks for many of our operations and find that they render very effective service. Hauls are usually short and the use of platform skids eliminates any loss of time for loading and unloading trucks. The endeavor is made to pick up return loads when making deliveries. Thus a truck delivering cans will bring back sheet metal to the can department. One taking empty boxes to storage will load up with goods ready for shipment when returning. This arrangement, in part, also explains why it has been found desirable to use all storerooms for diverse purposes.

Freight elevators are an important link in the chain of handling. They are located, in all but one instance, at points leading to two rooms on every floor. This saves a vast amount of travel and makes direct line routing largely possible. Where a steady flow of material is maintained we have such devices as the barrel elevator, and the many metal-slat belt-conveyors, chain-conveyors, roller-conveyors, and chutes in use at filling, sealing, and labeling stations. Our various conveying devices fit in exceptionally well with the automatic machinery at manufacturing and packing points. In fact, conveyors and machines together form efficient time-, labor-, and cost-saving units, wherever they have been installed.

Breakdowns of our handling equipment would practically shut down manufacture at the points where they might occur, so careful inspection, with timely repairs and replacements, is maintained to keep all apparatus in working order.

Cost Data on Handling

The various handling processes are intimately a part of the manufacturing procedure, and have been for a long time. Hence no comparisons of mechanical handling with the hand methods used in former days are on record. We have, however, kept a careful check on certain of our handling costs in the receiving- and shipping-rooms and these are given below. The figures include all expenses incidental to the loading gangs, except those of supervision, timekeeping, and similar items.

Unloading

Metal for cans	$0.02 per box
Caustic Soda in drums	0.02 per drum
Lime in drums	0.04 per drum
Fiber boxes (knocked down)	0.50 per thousand
Wood boxes	1.50 per thousand

Shipping

Per package	$0.0075

The shipping cost is an average for drums, barrels, and filled cases, regardless of size or contents. From month to month figures vary from the standards listed, according to the relative quantities of the many kinds of packages handled. As the above table gives average costs over a considerable period, however, it is actual and accurate.

Measuring the Savings of Mechanical Handling

Factors in the Selection of Equipment for an Installation

By W. T. SPIVEY

Consulting Engineer

Index Number
658.281 Mechanical handling

THE method of approach to any material handling problem has a far greater effect on the success of the resulting installation than any amount of time spent on mechanical features.

Attitude! Any man with experience in planning material handling layouts knows the tremendous significance of this word. He meets one plant owner who says, "We are spending too much money handling stuff by hand. We want you to help us cut the cost. Every man in our organization will co-operate with you."

Courtesy of Link-Belt Company

FIG. 1 CONVEYOR FOR HANDLING COAL
Typical of labor-saving devices for power plants.

Another, in the same industry, sends for every Tom, Dick, and Harry in the material handling business and *dares* each one to solve his problem. And when finally the unlucky bidder begins work he meets opposition on every hand. It is small wonder everybody concerned in the installation is sick of the job before it is finished.

The plant owner or manager with the open-minded, co-operative attitude has a far better chance of selecting the right man to make the analysis, and through this man to pick the best manufacturers to build and install his equipment. This man need not come from outside the plant, or even be known as a material handling engineer. True, as with the design of a power plant or other such specialized equipment, the man who spends his life in this work is likely to be the best man.

On the other hand the best equipped material handling plant I know of today has been planned by the maintenance engineer of the plant. *But this man knows equipment.* He is thoroughly acquainted with the most modern handling equipment, from the sugar centrals of Cuba to the automobile plants of Detroit. It is true his company has paid for a lot of his experimenting, and to this extent the plant owner may well question this line of approach.

This brings up a very important point. There is a great tendency among plant operating men to "go it alone" because they do not want to put themselves under obligation to an outsider. This may be all right, but is hardly likely to produce the best installation. Realizing this, the more progressive material handling manufacturers maintain in each industrial center engineers whose chief duty is to work with the plant engineers in developing material handling layouts. Obviously the time of such men is valuable, and it is not expected that any industrial plant will make use of their services except in good faith. On the other hand, these men do not expect every problem they work on to develop into a sale.

Experience Data are Essential

But whether the study is made by a plant man or an outsider, the man who does it must know what has been done in similar plants, and when he decides on the machine to use he must know the possibilities and limitations of this machine. It is very easy for an operating man to think that because he has used a certain machine "with reasonable success" for years, that he is right in installing other identical machines to meet additional needs. But can he afford to do this in the face of the tremendous improvements being made each year in material handling equipment?

This observation applies particularly to operating men in the less progressive industries. For example, textile manufacturing is one of the oldest of present industries, yet our baby industry, automobile manufacturing, has, in 20 years, made more progress in applying mechanical handling than the textile manufacturers have made in a century. As a result, it is very natural that some of the best ideas now in use in cotton manufacturing have been put into effect by a man trained in automobile assembly. This and similar experiences form the basic arguments for making broader use of the outside man.

The past 20 years' experience in organizing and

speeding up production has taught us the importance of adaptability and tact in making plant improvements. I have seen many a material handling problem solved "negatively" because the management tried to force it on a superintendent or foreman without first selling him the idea. These men very naturally have their own plans, which may be better than those from the outside. In any case, they are sure to have good ideas that will never be used unless the man planning the installation does his work tactfully.

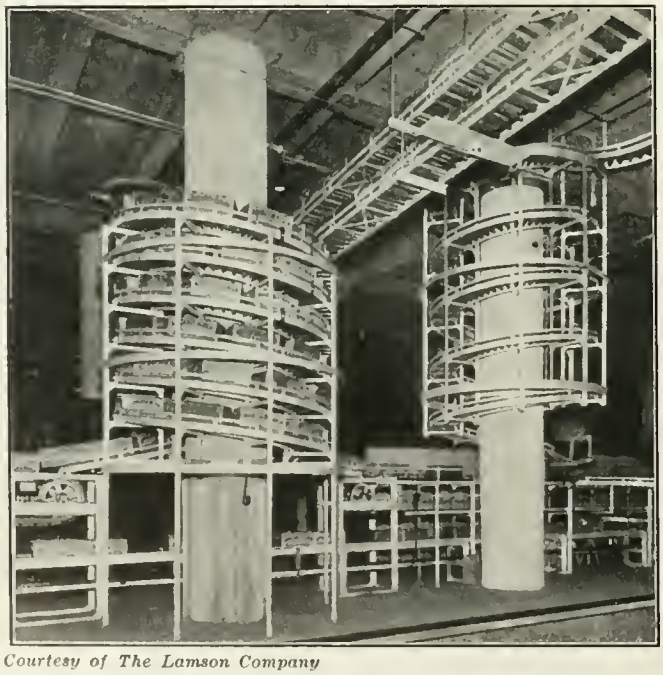
On account of this lack of tactful approach many executives refuse to install much-needed equipment because they think their foremen do not want it. I know such a case in the shipping business, where the general superintendent was positive the introduction of labor-saving equipment would meet with too much opposition to warrant attempting it. Yet one of the "key" foremen of this organization had talked to me enthusiastically about the results being accomplished by a piece of unloading equipment on a nearby pier.

Constructive imagination is the most important attribute of a man who attempts to lay out a material handling system. He must also have the co-operation of both management and foremen. As material handling equipment is most generally used in tying together different departments, it is sometimes hard to arouse the interest necessary to secure this co-operation.

A good illustration of this state of affairs may be had from an experience of the writer. I had tried for years to interest the management of a certain Atlantic seaboard wharf in the use of conveyors for unloading and storing goods. No progress was made, because it was the job of the shipowners to deliver goods from the ship to the dock, and the business of the wharf organization to take it from shipside to storage or cars. Five years ago this pier was taken over by a private company which operated its own ships. Immediately we had a different status. From ship's hold to the storage pile was one operation—one department under one head. Today they have a complete system of equipment.

Many people think they are co-operative because they are *willing* to have any change that involves no readjustment of their own time-honored arrangements. Last year I had occasion to install a long, heavy conveyor in a very crowded plant. The superintendent took the arbitrary stand that not one machine or pipe was to be moved. As a result, instead of using *one* conveyor (as would have been possible with a little rearrangement of several machines) it was necessary to use *three* conveyors, costing much more than the one, and involving two unnecessary transfer points.

In another plant a large spiral chute was installed. The logical place for it was near the center of one side of the building, over the shipping platform. Instead it was required to place it outside the building at one corner. Why? To save cutting the floors and to get a little extra storage space in the building. For these minor reasons the chute was put in the least useful place. Incidentally the housing and extra erection alone made the price of the chute almost double the estimate for the inside location.



Courtesy of The Lamson Company

FIG. 2 HANDLING PACKAGE GOODS BY CONVEYOR
This type of equipment finds wide industrial application.

Courtesy of The Lamson Company

FIG. 3 ROLLER CONVEYORS IN THE AUTOMOBILE INDUSTRY
Many machine shop processes are facilitated by mechanical handling.

Contrast these examples with the "economic approach" of one of the most successful confectionery manufacturers of the East. These people needed a portable car unloader, and they wanted a machine too long and heavy to be economically handled on the soft ground in their coal storage yard. Although the machine was installed on trial, they took the co-operative attitude that it was their job to give the machine a fair chance. So they built a large semi-circular concrete runway for the wheels of the unloader. The expense of this runway was repaid within the first year by the saving in labor of moving the machine, and the whole installation has been a complete success.

In many cases co-operation can economically be extended to include rerouting of goods in process. The evolution of quantity production in automobile manufacturing shows how essential it is to make the flow of product conform to certain lines, if mechanical handling is to be used at all. Compare these modern methods with those of the carriage builders of a short generation ago. The most cursory study will convince one that, from the first operation to the final assembly, the "right of way" has been given to conveyors, cranes, hoists, and overhead track systems.

Co-operation in routing bears a close relation to another big factor in the successful solution of material handling problems—the design of the building. While

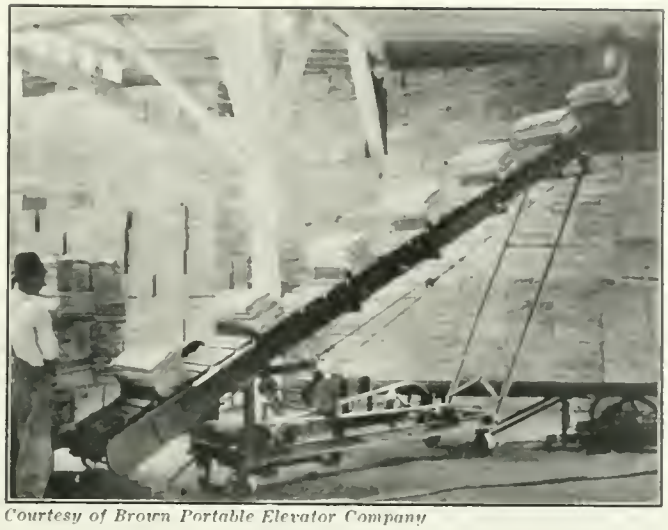
Courtesy of Link-Belt Company

FIG. 4 CONVEYOR USED IN ASSEMBLING VAPOR STOVES
Stoves are assembled, enameled, and dried in transit.

it is true that most equipment goes into existing buildings, an increasing percentage of installations is being made in new buildings. Unfortunately, many of these buildings are designed by people with very little vision of the present or future possibilities of mechanical handling. Many of these people make the compromise of leaving a few holes here and there in the floor—small considerations—when what is needed is a bigger and broader study of the entire layout.

From the earliest days of mechanical handling, grain elevators have literally been "built around" the elevators and conveyors, with the result that grain is probably handled more cheaply today than any other commodity. Even with this high development, however, the engineers of a big railroad recently spent weeks in the study of still better ways of doing this job. At the same time and in the same city municipal engineers were serenely designing a big pier along the same old conventional lines, with little regard for the labor-saving equipment long ago developed for handling package goods.

The modern boiler plant presents a good contrast to this lack of planning. Time was when such a building was designed to house the boilers. Today it is made to conform to coal supply, overhead bunkers and ash disposal. Such work is easier to lay out than manufac-



Courtesy of Brown Portable Elevator Company

FIG. 5 STORING BOX SHOOKS BY PORTABLE ELEVATOR
Economical in handling costs and storage space.

turing processes. True, but this does not alter the fact that every manufacturing building should have the same careful study of material handling given to it, whether it is intended to install the equipment at present or not.

The practice of buying mechanical handling equipment on price alone, produces a reaction the opposite from co-operation. Fortunately, the great majority of purchasing agents no longer follow this plan, but the practice still exists, and it is still responsible for many of the unsatisfactory installations of equipment.

The chief reason why this particular type of equipment cannot be bought in such a manner is that every installation is different and possesses a different possibility of saving. This statement, of course, applies not so much to individual material handling machines as to systems. However, the principle of "relative saving" is present with *all* such equipment.

Factors in the Buying of Equipment

With such a system of conveyors it is very seldom that two manufacturers will present the same layout, or estimate, or anywhere near the same grade of equipment. Some one man will almost invariably present more worth-while ideas than all the others together. Obviously it is only fair that he be given first consideration.

But the greatest loss to the purchaser who is a "price buyer" comes through the lack of interest his bidders take in his problem. They know very well that they will never be repaid for doing more than making up an estimate. In short, they put into the job a lot of detail work and very little advice.

The shrewd buyer will promptly say—"But competitive buying is an established principle of business and an essential one". That is true, and I would not like to see it eliminated. However, it can be applied to every material handling problem in such a way as to get both a good price and the best advice and assistance of some selected expert.

For example, any owner who is accustomed to act in good faith can easily find a thoroughly-trained manu-

facturer's representative willing to spend any reasonable amount of time working out a problem with the plant engineer. Furthermore, the representative will do it with the definite understanding that the finally approved plans are to be submitted to one or more other reputable manufacturers in the same line. But he will *not* do it if he thinks the plans will be "shopped" from pillar to post for the sake of a price only. It is only fair to the other manufacturers that they know who has aided in preparing the plans.

Instruction in Operation Is Important

No installation of equipment has ever carried with it a guarantee of success merely as a result of proper design and application. Last year a big paper mill bought a locomotive crane. The manufacturers sent an experienced operator to run it for a month. This man was an excellent crane operator but a very poor teacher. As a result the man he left to run the crane smashed two big machines and ended by dumping the entire crane into a ditch.

This man had not the slightest conception of the limitations of the crane nor the mechanical knowledge of its naturally complicated mechanism. So, while the crane is one of the best ever developed for doing the work this mill has to do, it is still making trouble after a full year of service. The application is right—the crane has the proper capacity and speed—but to this day no one has ever set about teaching the operator to handle it properly.

Fortunately, the importance of this principle of "teaching the user" is being recognized by some of the more progressive plants. One of the most successful operating men I have ever known said to me recently—"There was a time when I followed the common custom of having the 'departing' operator of a machine teach his successor. Now I have several men whose duty it is to instruct new machine operators. They are *real* teachers." This prompts the suggestion that it is not enough to do a little teaching in the beginning; just as long as the labor turnover is as high as it is today, it is necessary to keep it up.

Care and Maintenance Is Necessary

Another reason for instructing the actual user of the equipment in the plant, warehouse, or yard is that these men would otherwise never know just what the management *expects* the machine to do. A short time ago a wholesale drug house bought a tiering machine to handle cases weighing not over 500 lb. each. They knew when they bought it that they had a few cases weighing as high as 1200 lb., but there were so few of these that they bought the smaller machine to save money, weight, and space. As soon as the machine was installed the foreman started lifting the heaviest cases, overloading the machine and the motor, until the inevitable breakdown occurred.

Maintenance is an important approach to successful solution of any handling problem. When you assign a man to a definite machine operating directly before him, you are assured of very little trouble in getting him to take good care of it. The modern power-house is a good illustration. Because the man on the engine floor is moving about constantly among his engines and generators, it is very natural for him to keep them spick and span. Even though neatness may not be natural to him, he has a healthy respect for the frequent inspections such machines receive.

But if you want to see a contrast, go over his coal and ash handling system from the receiving hopper to the ash delivery! And yet, here you have one man responsible for one department, the power-house as a unit. How is it possible to insure the proper maintenance of a system of conveyors connecting many departments, an even more difficult proposition? The answer is, by defining responsibility.

Courtesy of Pawling and Harnischfeger Company

FIG. 6 GASOLINE-DRIVEN CATERPILLAR-TYPE CRANE
One of the many kinds supplanting hand labor.

We make a lot of fuss about idle time of individual production machines. How much more important it is that we have no idle time on a conveyor that serves a *dozen* machines, to say nothing of the additional depreciation resulting from neglect!

In this article I have first discussed the basic considerations entering into the solution of every material handling problem, the man for the job; co-operation; methods of buying; operation and maintenance.

"But," the plant manager may well say, "assume that I am ready to approach the problem as suggested above. How am I to know whether it will pay me to install mechanical handling equipment?" Every manufacturer has had his own methods of proving to the customer the advantages arising from the use of his own product. At the opposite end every plant engineer has *his* way of figuring out the amount he can afford to spend on any given installation. Unfortunately these two people do not often see things from a common point of view. And even when they do, there has been no general formula to establish a basis of procedure.

One reason no such formula has been developed is that so many men object to the suggestion that their material handling problems can be solved by formula. They are just as near right as when they say that no

power plant problem can be reduced to formula. Yet they know that a mass of formulæ underlie all power plant design.

When I talked with one operating man very well informed on material handling he said, "When I need such equipment, *I know I need it.*" No formula, general or specific, will help that man. But he represents one case in a hundred. Very few operating men, dealing with a thing as relatively new in development, and as fast growing, as mechanical handling, can hope to know from previous experience or intuition when they need equipment.

So, for this reason and others, a few of the more progressive engineers interested in the subject have been steadily working toward the establishment of a more common basis on which to make comparative cost analyses.

These efforts have been crystallized in the very progressive action of the American Society of Mechanical Engineers. At the May 1923, meeting of the Society was presented, for the first time, the basic elements of a formula that promises to serve the field of material handling as well as many similar formulæ have served in the development of other lines of engineering. This formula consists of the following equations:[1]

$$Z = \frac{(S+T+U-E)X}{A+B+C+D} \quad \ldots\ldots [1]$$

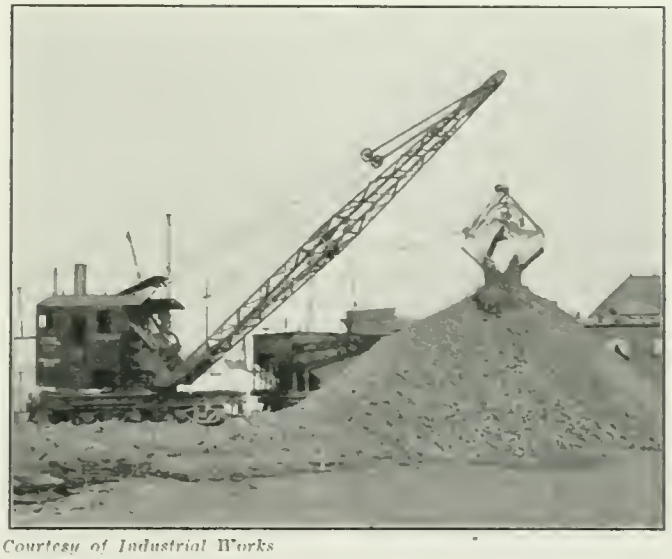
$$Y = I\,(A+B+C+D) \quad \ldots\ldots [2]$$

$$U = [(S+T+U-E)X] - Y \quad \ldots\ldots [3]$$

It is not to be expected that this formula will be used without judgment, nor that every element of it will appear in the solution of every problem. Indeed, the first time I applied the formula to a practical problem the solution was so simple that I might well have said, "Why use it at all?" And yet by this method of presentation, the superintendent of the plant was able easily to convince the owner of the economy of a conveyor that he had needed for five years.

Another man criticized the formula because he was sure he had a better method. When we analyzed his own method we found that he was actually using the formula without knowing it. In other words, he was doing what a lot of people will do unconsciously, question the *value* of the formula because of its *form*. But if we are to get anywhere we must have a commonly accepted form. Those who have tried hard to suggest other forms have ended by pronouncing this the best.

In contrast to these people who think the formula too specific there are other engineers who believe that more definite numerical values should be assigned to the various elements represented by letters *A*, *B*, *C*, *D*, etc. (See Footnote 1.) This can be done, and very probably will be the next step in the development and use of the formula. However, it will always be necessary to consider operating conditions in assigning values. After a recent talk on this subject one man asked me why, as an illustration, I gave the life of a certain belt-conveyor



Courtesy of Industrial Works

FIG. 7 LOCOMOTIVE CRANE EQUIPPED WITH BUCKET
Extensively used in the handling of loose bulk materials.

at 10 years. He said he had one like it that had been running 20 years. But he had replaced the belt itself twice during this period, and had taken exceptional care of the entire machine.

This case suggests the necessity of developing standard, accepted values for the depreciation and obsolescence of the various elements of a system or a machine. This would not be extremely difficult, and once done, it would be very easy for any operating man, referring to a table, to apply to the formula the proper values to fit his own operating conditions and the machine he intends to use. As it is today he has to depend on his own limited experience or on the widely varying opinions of others.

General use of this formula will help to correct the very common error of ignoring the saving made in

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[1] For an exposition of the formula and features of its application see MANAGEMENT AND ADMINISTRATION, October 1923, p. 443, "Economy Formulas for Labor-Saving Equipment" (Taken from the committee report); and December 1923, p. 739, "Profit or Loss in Material Handling," by James A. Shepard.

For the reader's convenience, the factors entering into the formula are explained below:

Let:

Debit Items:
- A = percentage allowance on investment.
- B = percentage allowance to provide for insurance, taxes, etc.
- C = percentage allowance to provide for upkeep.
- D = percentage allowance to provide for depreciation and obsolescence.
- E = yearly cost of power, supplies, and other items which are consumed, total in dollars.

Credit Items:
- S = yearly saving in direct cost of labor, in dollars.
- T = yearly saving in fixed charges, operating charges or burden, in dollars.
- U = yearly saving on earning through increased production, in dollars.

- X = percentage of year during which equipment will be employed.
- I = initial cost of mechanical equipment.

Results:
- Z = maximum investment in dollars justified by the above consideration.
- Y = yearly cost to maintain mechanical equipment ready for operation.
- U = yearly profit from operation of mechanical equipment.

Feeling that handling machinery, even if left idle a large part of the year, would probably require, under most conditions, approximately the same repair through deterioration as though in use, the Committee makes no deduction for such lack of use in the estimated cost of upkeep C. If greater accuracy be considered necessary, use C multiplied by X in place of C in the formulas.

operating burden by the installation of labor-saving equipment. The fact that this burden usually amounts to considerably more than the actual direct labor, makes it all the more reasonable that we should take it into account.

Quoting from the above-mentioned report of the American Society of Mechanical Engineers Committee:

> In principle the desired formula represents simply a mathematical expression of such debit and credit items as are involved in the proposed new method, or process, as compared with previous practice. In highly organized and thoroughly systematized industrial practice, however, direct expenditures and direct economies are frequently of less importance in their monetary value than related incidental expenditures and economies. For instance, labor is employed in the factory for processing of raw material, which is thereby enhanced in value and becomes the factory's product. As a rule the total cost of the process will consist of, say, one part "direct labor" (labor which can be charged directly to a single process, or part of the product) and from one-half to three parts "fixed charge," "burden," or operating charge, consisting of "indirect labor" (labor which is of general utility and not chargeable directly), and such items as superintendence, employees' liability, welfare activities, maintenance of building and machinery, fuel, supplies, insurance, depreciation, taxes, accounting, etc.

To take into account this saving in burden the formula carries the credit item T.

Considering a very simple installation recently made by the author—a conveyor running from one machine to another—the saving in direct labor was the time of one man. Obviously the saving in burden (superintendence, employee liability, welfare work, etc.) was small, but it was *appreciable*, and when it was entered in the formula it made a decided difference in the amount this plant could afford to pay for the conveyor.

Examples of Big Savings from Equipment

On the other hand, in a conveying system installed during the past winter the burden credit item was big. In direct labor this system replaced six truckers and a fleet of hand-trucks. But these men were using already overcrowded elevators, blocking narrow aisles and interfering with production machines, in their movement about the plant. Also, while it was not considered in the preliminary analysis, one labor foreman was eliminated. Adding these savings to the various overhead and indirect labor expenses that must be charged to the cost of every laborer in the plant, we found that this firm could well afford to pay more than twice as much for this system as would have been justified by the saving in direct labor alone.

A food products plant, typical of many factories in crowded cities, recently made a thorough study of their handling problems. Like numberless others, this plant had grown from a small building to such a size that it was necessary either to move, with all the expenses involved in new location and building, or to speed up production. They found that by using mechanical handling equipment they could increase production by more than one-third, enough to keep up with their sales expectations. The profits on this increase in production alone have been so large that they have paid for the equipment several times over within the past four years.

In addition to this saving, the handling equipment has saved 35 men. Can anyone say it has not saved a big amount in superintendence and all the other burden items, in addition?

Nor is the plant in the crowded city location the only one that can make use of material handling machinery to increase production without new buildings. Many a plant has invested in a new building to do no more

Courtesy of Shepard Electric Crane and Hoist Company

FIG. 8 ELECTRIC HOIST HANDLING COILS OF WIRE
Hoists save labor and expense in practically every industry.

than could be accomplished, at far less expense, by the use of mechanical handling equipment.

Without question it is often difficult, or even impossible, to establish a "credit" due to increased production. However, as with operating burden, there is every reason why, in making the analysis, we should study assigning of a value to the credit item U.

By expressing the formula in the several different ways shown, the three results obtained form a check on each other. The values to be assigned to the debit items A, B, C, D, and E (see Footnote 1) will, until more commonly accepted values are established, depend on each individual installation and on the prevailing accounting practice in each plant.

Fortunately, it is possible to assign very conservative values to these items and still arrive at far more accurate results than with the conventional methods of analyses. This is the best proof of the value of the formula to the industrial owner and manager.

Materials Handling Methods That Have Added to Industrial Profits

Experience Data from 55 Plants Using Larger Equipment

By GEORGE E. HAGEMANN

Associate Editor, MANAGEMENT AND ADMINISTRATION

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658.281 Mechanical handling
658.281(002) Cost of conveyor systems

EVERY installation of materials handling equipment is made with the object of bringing about greater economy of plant operation. Ultimately the installation adds to profits, either increasing the margin or maintaining it in the face of stronger competition.

All arguments as to labor shortage, uncertainty of hand operations, speed of production, conservation of space, elimination of waste motions, and similar items, are finally resolved into a dollars and cents comparison. If a saving shows up in favor of mechanical equipment, and the initial cost is an expense which receives executive approval from the general manager, president, or board of directors, depending on the amount involved, the installation is made. If no saving is demonstrable, the matter is considered closed.

The data compiled in this article show actual savings in costs and labor that have been obtained in a wide variety of industries using the larger types of equipment. Where detailed figures were obtainable they are given. In some cases only total savings, either in money or man-hours, were available.

Data are classified under the following heads: tractractors; large conveyors; portable conveyors; locomotive cranes; electric cranes and hoists; loading machines for mine cars; cupola charging machines.

Equipment of the Tructractor Type[1]

The Standard Sanitary Manufacturing Company, at its Pittsburgh works, has installed four Clark Tructractors for use in connection with foundry operations in the making of bathtubs and basins. Two are of the dump body type and two of the tructractor type. They operate 18 hr. per day, two 9 hr. shifts.

One of the dump tructractors hauls 2800-lb. loads of sand about 100 yd. over rough ground at the rate of 49 tons per shift. Another does general work. One tractor hauls patterns and acts as a tractor for buggies, and the other handles scrap.

A great advantage of the present hauling method is its increased capacity. Comparative cost figures are given in Table 1.

An installation at the American Radiator Company's Buffalo works consists of five Clark Tructractors, two for hauling materials to and from the foundry and three for general work. The first was purchased over five years ago. All machines operate day and night every day except Sundays and holidays, and sometimes one shift on these days. All are equipped with dump bodies to handle sand.

Two work for the foundry and move about 39 loads per day. One driver operates two machines, his helper loading the second while the first is in transit. Loads vary from 840 to 3000 lb., and the two machines handle 42 and 101½ tons in the day and night shifts, respectively. Table 2 shows comparative costs.

TABLE 1. COST OF OPERATION—
CLARK AUTOMATIC DUMP TRUCTRACTOR
Standard Sanitary Mfg. Co.

HAULING SAND—18 HR. PER DAY	
Depreciation—$1,610.25 ÷ 4 yr. of life	$102.56
[1]Average interest at 6 per cent $= \frac{5}{4} \times \frac{\$1,610.25 \times 0.06}{2}$	60.39
Repairs and maintenance (including tires, periodic overhaul, inspecting, and greasing)	300.00
Allowance for breakage due to accidents	200.00
Fixed expense per year	$962.95
Fixed expense per shift—$962.95 ÷ 672 shifts	$1.43
Gasoline—4 gal. × $0.21	0.84
Oil—¼ gal. × $0.50	0.13
Operator's wage—$0.23 per load × 35 loads	8.05
Loader's wage—$0.18 per load × 35 loads	6.30
Total cost per shift, including loader	$16.75
Total cost per ton—$16.75 ÷ 49 tons	0.342
Cost per shift, not including loader	10.45
Cost per ton, not including loader—$10.45 ÷ 49 tons	0.213
COMPARISON WITH HAND METHOD, USING WHEELBARROWS	
Hand method—cost per shift—5 men × $6	$30.00
(Piece rate system—$6 per man. Five men to handle 25 tons per shift)	
Cost per ton—$30 ÷ 25 tons	1.200
Tructractor method—cost per ton (from above)	0.342
Saving per ton (in hauling cost)	$0.858
Saving per yr. (in hauling cost)—$0.858 × 49 tons per shift × 672 shifts	$28,252.22
This annual saving is 17 times the cost of the equipment, and repays the entire cost of the Tructractor in 22 working days	

[1]Allowing for interest earned by depreciation reserve.

The American Radiator Company operates Clark Tructractors in many of its other plants, and owns, at the date of this report, a fleet totaling 20 machines, consisting of the following:

Hand Hoist Tructractors	8
Auto Dump Tructractors	7
Tractor Model	1
Clark Truclifts	4
Total	20

If all these machines are being used as effectively on their respective tasks as the two at the malleable iron plant at Buffalo, the net annual earnings (i. e., profits) of the entire fleet amount to $35.29 × 312 × 20, which equals $220,209.60. These are net profits after full

[1] Reports on this type prepared by A. C. Nielsen Company.

TABLE 2. COST OF OPERATION OF TWO CLARK TRUCTRACTORS

American Radiator Co.—Malleable Iron Plant

HAULING SAND, COAL, COKE, AND FOUNDRY REFUSE	
Depreciation—2 tructractors—$3,250 ÷ 6 yr	$541.67
[1]Average interest at 6 per cent—$\frac{7}{6} \times \frac{\$3,250 \times 0.06}{2}$	113.75
Maintenance and repairs—2 × $250	500.00
Total annual fixed costs	$1,155.42
Fixed costs per working day—$1,155.42 ÷ 312	$3.70
Cost of driver—day shift	7.65
Cost of driver—night shift	7.65
Gasoline—2 shifts—3 gals. × $0.18	0.54
Oil—2 shifts	0.12
Total operating costs per day—2 tructractors	$19.66
Average cost per ton of material handled—$19.66 ÷ 52.5 tons	$0.374
SAVINGS EFFECTED BY USE OF TRUCTRACTORS	
Cost per day of doing work by hand—piece-work basis:	
Day shift—13 men × $5.25	$68.25
Night shift—4 men × $5.50	22.00
Total per day	$90.25
Cost per day using tructractors	19.66
Saving per day	$70.59
Saving per yr. by 2 Clark tructractors—$70.59 × 312	$22,024.08
Average cost per ton by hand—$90.25 ÷ 52.5	$1.719
Cost per ton using tructractors	0.374
Saving per ton	$1.345
This saving paid for cost of tructractors in 46 working days	

[1]Allowing for interest earned by depreciation reserve.

allowance has been made for 6 per cent interest on the investment, depreciation, maintenance, and operation.

At the Holt Manufacturing Company plant the first tructractor was purchased in 1919, and four are now in use. Three are the regular tractor type, while the fourth has a dump body for carrying sand and foundry supplies. This one is also used as a tractor.

In the manufacture of "Caterpillar" tractors, tructractors are used to haul 4-wheel trailers which handle the castings. Besides these duties they take care of foundry supplies and material received by rail. The longest haul is 1,000 ft. and the average 500 ft. Five trailers with 3-ton loads apiece are pulled at once. Some days one machine will handle 50 tons, but the daily average for all four is 25 tons. See Table 3.

At the plant of the Reo Motor Company 6 tructractors are in operation. Five are of the tractor model and one is equipped with a dump body. Recently a truelift has been installed.

The factory covers an area of about 25 acres and some of the hauls are as long as a half-mile. About 500 trailers of several different styles are in use. They all fit together in trains, 6 being handled at once. Trailer loads vary from 1 to 2½ tons. A driver and helper work together. Costs are given in Table 4.

Conveying Systems

The Architectural Tile Company uses a system consisting of a bucket elevator and screw conveyors, installed by the Weller Manufacturing Company,[2] for the handling of felspar, flint, silica, and clay. Table 5 shows the actual relative economy of the new method over the old. The floor space saved is 50 per cent. The equipment is now used at only one-fifth capacity.

[2] Reports on Weller Equipment prepared by A. C. Nielsen Company.

Within the past year a conveying system for rock salt was put in operation at the plant of the Carey Salt Company. One part of this system is a bucket elevator which lifts the salt, after it is crushed to 2½ in. diameter, to the top of the plant, for screening and recrushing to smaller sizes. This elevator runs at a speed of 95 ft. per min. and handles an average of 285 tons of new salt per day, in addition to that which must be recrushed. The ultimate output is to be 380 tons per day. Table 6 shows the cost figures on this apparatus, which was made by the Weller Manufacturing Company. As it was not installed to replace hand labor, no actual comparisons can be made.

TABLE 3. COST OF OPERATION—CLARK TRUCTRACTORS

The Holt Mfg. Co.

Depreciation—$1,525 ÷ 5 yr	$305.00
[1]Average interest at 6 per cent—$\frac{6}{5} \times \frac{\$1,525.00 \times 0.06}{2}$	54.90
Repairs and maintenance, including annual overhaul	200.00
Tires, one set	113.50
Gasoline—3 gal. per day × 300 days × $0.09 per gal	81.00
Oil—¼ gal. per week × 52 weeks × $0.80 per gal	10.40
Operator—48 hr. × 52 weeks × $0.55 per hr	1,372.80
Yearly cost of operation—one Clark tructractor	$2,137.60
Daily cost of operation—$2,137.60 ÷ 300	7.13
Daily cost of operation, excluding driver—$764.80 ÷ 300	2.55
Yearly cost of operation—4 Clark tructractors	$8,550.40
Cost per ton moved = $\frac{\$8,550.40}{100 \text{ tons} \times 300 \text{ days}}$	0.2850
COST OF TRAILERS PULLED BY TRUCTRACTORS	
Depreciation—$250 ÷ 8 yr	$31.25
[1]Average interest at 6 per cent—$\frac{9}{8} \times \frac{\$250 \times 0.06}{2}$	8.44
Repairs and maintenance	20.00
Cost of one trailer per yr	$59.69
Cost of 50 trailers per yr	$2,984.50
Helpers' wages—48 hr. × 52 weeks × $0.50 per hr. × 4 men	4,992.00
Total cost of operating trailers, per year	$7,976.50
Cost per ton carried by trailers = $\frac{\$7,976.50}{100 \text{ tons} \times 300 \text{ days}}$	$0.2659
DIRECT SAVINGS DUE TO TRUCTRACTORS	
Annual operating cost of 4 electric tractors and 4 operators—4 × $2,200	$8,800.00
Wages of 4 men on car unloading gang (a saving by elimination of a re-handling operation)—4 × 48 hr. × 52 weeks × $0.45 per hr	4,492.80
Total annual saving	$13,292.80
[2]INDIRECT SAVINGS DUE TO TRUCTRACTORS	
Increase in efficiency of the Transportation Department	25 per cent
Increase in speed of getting out repair orders	15 per cent

[1]Allowing for interest earned by depreciation reserve.
[2]While these savings cannot be evaluated, the owner considers them of even greater importance than the monetary savings.

TABLE 4. COST OF OPERATION—ONE CLARK TRUCTRACTOR

Reo Motor Company

Depreciation—$1,595 ÷ 8 yr	$199.38
[1]Average interest at 6 per cent—$\frac{9}{8} \times \frac{\$1,595.00 \times 0.06}{2}$	53.83
Annual maintenance and repairs, including tires, overhauling, inspecting, greasing	135.00
Annual fixed expense	$388.21
Fixed expenses per day—$388.21 ÷ 300 days	$1.29
Gasoline—5 gal. at $0.16 per gal	0.80
Lubricating oil—⅛ gal. at $0.60 per gal	0.08
Labor—Operator 10 hr. at $0.60 per hr $6	
Helper 10 hr. at $0.40 per hr 4	10.00
Total operating cost per day	$12.17
Cost per day without helper	8.17
Cost per day (not including driver and helper)[1]	2.17

[1]The tractor for hauling motors has only one operator (no helper) and handles 180 motors per day, the cost per motor being $0.045.

[1]Allowing for interest earned by depreciation reserve.

TABLE 5. COST OF OPERATION OF WELLER CONVEYING SYSTEM

Architectural Tile Co.

Depreciation—$5,000 ÷ 20 yr.	$250.00
[1]Average interest at 6 per cent—$\frac{21}{20} \times \frac{\$5,000 \times 0.06}{2}$	157.50
Maintenance and repairs—estimated	150.00
Annual fixed costs	$557.50
Fixed cost per working day—$557.50 ÷ 280	1.99
Fixed cost per car load of material handled—$557.50 ÷ 150 cars	$3.72
Labor cost per load—2 men × 3 hr. × $0.15	2.70
Power	0.24
Total cost per load	$6.66
Average cost per ton	0.178

SAVINGS EFFECTED BY CONVEYING INSTALLATION SUBSTITUTED FOR WHEELBARROW HANDLING

Cost of unloading a car by hand—4 men × 2 days × $4	$32.00
Cost of unloading a car with conveyor	6.66
Saving in labor per car	$25.34
Saving in labor per year—$25.34 × 150 cars	3,801.00
Saving in demurrage charges	175.00
Saving in floor space—2,240 sq. ft. × $0.15	336.00
Total saving per year	$4,312.00
Total saving per ton—$4,312.00 ÷ 5,625	0.766

This saving pays for the entire cost of the installation in less than 14 months.

[1]Allowing for interest earned on depreciation reserve.

TABLE 6. COST OF OPERATION OF WELLER BUCKET ELEVATOR

Carey Salt Company

Depreciation—$3,085 ÷ 10 years	$308.50
[1]Average interest at 6 per cent—$\frac{11}{10} \times \frac{\$3,085 \times 0.06}{2}$	101.80
Power—135 kw. hr. × 300 days at $0.02	$810.00
Maintenance—4½ hr. × 52 weeks at $0.35 per hr.	81.90
Repairs—none, to date	
Labor—none required	
Total cost of operation per year	$1,302.20
Cost per 9 hr. day (300 days per yr.)	$4.34
Cost per ton handled (present actual figures) $\frac{\$4.34}{285 \text{ tons}}$	0.015
Cost per ton handled when maximum output is attained $\frac{\$4.34}{380} =$	$0.0115

[1]Allowing for interest earned by depreciation reserve.

In the power plant of the Freeman Dairy Company a coal conveyor installed in 1923 handles 2,555 tons of coal annually from the bins to the firing floor. Lack of space prevents direct discharge into the stokers. The apparatus is used only 1½ hours per day. Table 7 shows the cost comparison between hand and mechanical methods.

A Link-Belt coal conveyor which handles 10,000 tons annually was installed in a western coal yard 16 years ago. Cars are unloaded at the rate of 25 tons per hr. The apparatus has to be operated only part of the time. Figures are given in Table 8.

In progressive foundry operations conveyor systems have brought about savings. The Kelsey Wheel Company has doubled production by installing a Link-Belt mold-conveyor. Previously one-half day was used in molding and one-half day in pouring. As the *hourly* output is the same under both schemes, the *daily* output is twice as great under mechanical methods. Only one-tenth of the floor space is required, steady work is obtained from each employee, and helpers to move the product have been eliminated. No cost data in figures are available.

Portable Conveyors

The Atlantic Coast Electric Railway Company operates three portable conveyors, furnished by the Portable Machinery Company, to handle coal. Formerly the work was performed by shovel and wheelbarrow. About 70 days' work per year is required to handle the total 24,000 tons of incoming fuel under either method, but four men with the conveyors now do the work of the previous 30, saving 260 man-hr. per day. In addition the storage capacity of the space is greatly increased. Table 9 shows the comparison.

Locomotive Cranes

At the Warren Foundry and Pipe Company three methods of handling are used[3]—electric traveling cranes on yard runways, locomotive cranes, of which three of the Industrial Works are in service, and hand work. One operator runs an electric crane, three men operate each locomotive crane, and from 8 to 12 men are required on corresponding work by hand labor. Table 10 shows comparative costs.

At the American Splint Corporation, a 15-ton Industrial crane handles 50,000 ft. of logs in a 9-hr. day, piling 30 to 40 ft. high and back piling to the same height, doubling yard storage. The crane and three men do the work formerly requiring 12 men, or at a cost of $19.17 per day against $75.60 formerly, saving $55.43 per day or $16,629.00 in 300 working days.

The Columbia Sugar Company uses an Industrial crane in handling coal, sugar beets, limestone, etc. Five hundred tons of coal are handled daily at a cost of 1½ cents per ton. Time required, 30 min. Cost by hand 8 cents per ton; time 10 hr. per car. Four hundred twenty-five tons of beets are handled per day; cost by hand 9 cents per ton; by crane 2 cents per ton. Fifty-ton car unloaded by crane in 45 min.; by hand this requires 7 hr.

TABLE 7. COST OF OPERATION OF WELLER COAL CONVEYOR

Freeman Dairy Co.

Depreciation—$1,300 ÷ 20 yr.		$65.00
[1]Average interest at 6 per cent—$\frac{21}{20} \times \frac{\$1,300 \times 0.06}{2}$		40.95
Repairs and maintenance		20.00
Power—680 kw. hr. × $0.0175		11.90
Total operating cost, excluding labor		$137.85
Labor 4,380 hr. × $0.60		2,628.00
Total cost of getting coal from bin to stokers		$2,765.85
Cost per ton of getting coal from bin to stokers	$\frac{\$2,765.85}{2,555}$	1.08
Cost of conveyor per ton of coal handled (if discharge were directly into stokers)	$\frac{\$137.85}{2,555}$	0.054

SAVINGS EFFECTED BY COAL CONVEYOR

Labor cost without conveyor—24 hr. × 365 days × $0.60		$5,256.00
Present cost with conveyor		2,765.85
Saving per year due to conveyor		$2,490.15
Saving per ton due to conveyor	$\frac{\$2,490.15}{2,555}$	0.98

This saving repays the cost of the investment in 6 months.

[1]Allowing for interest earned by depreciation reserve.

[3] See MANAGEMENT AND ADMINISTRATION, November 1923, p. 611, "A Cost Comparison in Handling Materials," by Shellman B. Brown.

A 35-ton Industrial crane belonging to the Sullivan Granite Company performs all the functions of handling bulk and unit materials. Six laborers at 65 cents an hr. costing $5.20 a day or $8,000 per year are replaced. Little can be done by six men; but $8,000 per year pays the cost of operating the crane, including operator, interest on investment and depreciation. In addition, the crane does work impossible for the men.

TABLE 8. COST OF OPERATING LINK-BELT CONVEYOR

Additional Shed Costs	
Depreciation $\frac{7000}{20}$	$350.00
Average interest at 6 per cent $\frac{7000\times0.06}{2}\times\frac{21}{20}$	220.50
Repairs	200.00
Taxes on shed	64.29
Insurance on shed and contents	262.50
Total annual charges	$1,097.29
Costs of Operating the Equipment	
Depreciation[1] $\frac{3500}{16}$	$218.75
Average interest at 6 per cent $\frac{3500\times0.06}{2}\times\frac{17}{16}$	111.56
Repairs[2]	187.50
Oil, waste, etc	50.00
Power $\frac{10,000}{25}\times50\times0.03$	600.00
Labor[3] $\frac{10,000}{40}\times\$2.88$	720.00
Taxes	85.71
Insurance	350.00
Total annual charges on machinery	$2,323.52
Add annual charges on shed	1,097.29
Total annual charges for mechanical handling	$3,420.81
Cost per ton	0.342
Cost with Hand Methods	
10,000 tons annually ÷ 40 tons per car = 250 cars	
Unloading 250 cars × 15 hr. per car × $0.60 per hr. =	$2,250.00
Loading 250 cars of coal into trucks × 20 hr. × $0.60 =	3,000.00
Total annual charges for hand methods	$5,250.00
Cost per ton	0.525
If loss of time by motor trucks is assumed as equivalent to a cost of 25 cents per ton, then 10,000 × $0.25 adds annually	2,500.00
Hand shoveling	5,250.00
Total costs—hand methods	$7,750.00
Costs per ton	0.775

[1]This figure assumes that apparatus is now worn out. Although 16 years old it is still in first-class condition.
[2]Including damage from a fire.
[3]Three men at $0.60 per hr. each, unloading a 40-ton car.

On the Chicago Eastern Illinois Railroad a 15-ton Industrial crane stocks coal from cars to bins at the rate of 50 tons in 16 min. Cost of handling 1⅜ cents per ton. Crew consists of three men.

On the Boston Elevated Railway a 10-ton Industrial with a crew of operator and two men carries out the following:

Unload from flat cars 540 ties per hr. Formerly took twelve men 2½ hr. Crane piles ties 18 ft. high. Men could pile only 12 ft. high.

Handling cages of treated wood block paving. Crane will dump 12 cages or about 18,000 blocks per hr. Same work formerly took 12 men about 4 hr.

Crane and crew handle about 75,000 ties and 1,500,000 bd. ft. of lumber per year.

The Delaware River Steel Company operate three Brownhoist cranes for work in their blast furnace plant. On one, a 15-ton type, they have kept costs. The other two do miscellaneous work. All are run 16 hours a day and are used two-thirds of the time, as each of the three in turn is taken out of service for inspection and repairs. The work consists of handling ore, coal, coke, limestone, pig iron, and slag. Table 11 shows cost data.[4]

A 20-ton Link-Belt crane and six men load on freight cars an average of 25 crated Hupmobiles daily for export shipment. Each crate weighs 4,000 pounds. Recently this crane loaded 28 crated automobiles on freight cars in 1½ hours. This work alone formerly required the full time of 30 men.

The crane is also used for unloading coal and building material from freight cars. At top speed it unloads a 70-ton car of coal in 40 minutes—while with hand-shoveling it would take 4 men practically the entire day to unload one car.

On the basis of 6 months' actual service the crane has saved the entire time of 35 laborers—something over $40,000 yearly in wages—and pays for itself every 4½ months from the standpoint of labor economy alone.

TABLE 9. COST OF COAL HANDLING BY PORTABLE CONVEYOR

Atlantic Coast Railway Company

By Conveyor	
Depreciation[1] — $\frac{3\times\$640+\$160}{12}$	$173.50
Average interest at 6 per cent $\frac{13}{12}\times\frac{2080\times0.06}{2}$	67.60
Repairs, maintenance, oil, etc	280.00
Electric current	260.00
Labor, 4 men, 70 days at $5 per day	1,400.00
Total	$2,181.10
Cost per ton	0.091
Cost Under Hand Methods	
Annual cost of owning and maintaining 30 wheelbarrows and 30 shovels	$430.00
Labor—30 men, 70 days at $5 per day	10,500.00
Total	$10,930.00
Savings per year	8,749.00
or the equipment paid for itself every 75 days	

[1]Conveyors cost $640 each. Total wiring cost $160.

TABLE 10. MATERIAL HANDLING COSTS

Warren Foundry and Pipe Company

Method	Approx. Cost per Hr.	Approx. Cost per Ton
Handling Pig Iron:		
Electric crane and magnet	$2.40	$0.06
Locomotive crane and magnet	3.20	0.08
Hand labor (one man contract)	0.75	0.25
Handling Molding Sand and Clay:		
Locomotive crane and bucket	$3.20	$0.08
Hand-shoveling (one man)	0.45	0.15
Hand-shoveling (high piles)	0.60	0.20
Handling Core Sand and Clay:		
Locomotive crane and bucket	$3.20	$0.08
Hand-shoveling, 8 men	3.60	0.29
Hand-shoveling, (high piles) 12 men	5.40	0.44

Cost of Locomotive Crane Repairs, Year 1922:

Possible hours of operation	307 × 10 × 3 = 9210 hr.
Actual hours of operation	8040 hr.
Hours idle for repairs or lack of work[1]	1170 hr.
Cost of repairs—labor	$2469
Cost of repairs—supplies	1557
Cost of repairs—total[1]	4026
Cost of repairs per hr. of service	0.50

[1]One crane down 660 hr. out of a possible 3070 for general and extensive overhauling.

[4] Report compiled by H. P. Gould Company.

TABLE 11. 15-TON BROWNHOIST LOCOMOTIVE CRANE

Delaware River Steel Co.

OPERATING ON STOCK PILE WITH 1½ CU. YD. BUCKET

Depreciation—$\frac{\$19,638}{10 \text{ yrs.}}$		$1,963.80
Average yearly interest at 6 per cent = $\frac{11}{10} \times \frac{\$19,638 \times 0.06}{2}$		648.05
Repairs and maintenance		1,000.00
Fuel 1 ton per day × 365 days × ⅜ = 243¾ tons × $8.00		1,946.64
Labor—1 operator × 60 cents per hr. × 24 hrs. × 365 days	= $5,256.00	
1 fireman × 42 cents per hr. × 24 hrs. × 365 days	= 3,679.20	
	$8,935.20	
$8,935.20 × ⅜		5,956.80
Total annual operating cost		$11,515.29
Tons handled, Ore	120,000	
Coal and Coke	50,000	
Limestone	1,000	
Total	171,000 × ⅔	114,000
Cost per ton = $\frac{\$11,515.29}{114,000}$		$0.1010
Cost of hand labor = 20 men × $4.50 per day × 365 days × ⅔		$21,900.00
Cost of crane operation		11,515.29
Net annual saving on 1 crane		$10,384.71
Cost per ton, hand method—$\frac{\$21,900.00}{114,000}$		$0.1921
Cost per ton, crane method		$0.1010
Net saving per ton		$0.0911

The crane pays for itself every two years.

TABLE 12. COMPARISON OF COSTS FOR OPERATING POWER-DRIVEN JIB CRANES AND NILES ELECTRIC TRAVELING CRANES. YEAR 1923[1]

Warren Foundry and Pipe Company

Type of Crane	Ratio of Tonnage Output	Direct Labor per Ton	Repairs (Labor and Supplies) per Ton	Total Cost of Crane Operation per Ton	Ratio of Cost of Repair Labor to Supplies	Ratios of Repair Labor Between the Foundries	Ratios of Supplies Between the Foundries
Jib	1.00	$0.984	$0.294	$1.278	1.37	1.00	1.00
Electric Traveling	2.25	0.335	0.348	0.683	0.90	2.18	3.33

[1] No overhead included.

Electric Cranes and Hoists

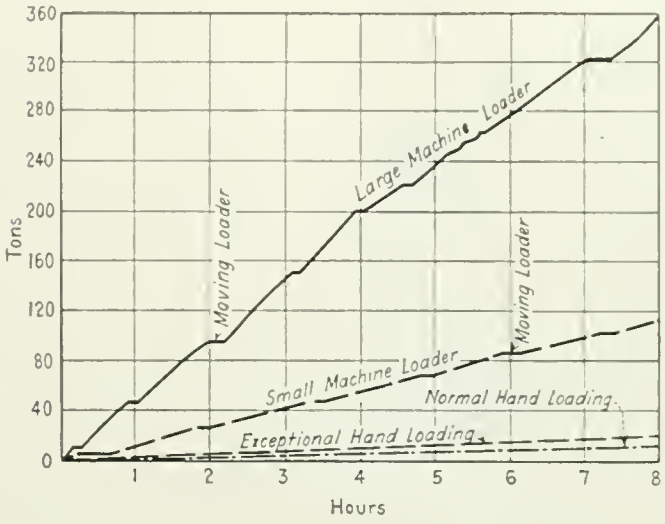
But little data were obtainable on economies of electric traveling cranes, as they are devices which have grown with the needs of modern industry and do work that never could have been performed by hand labor.

One comparison has been obtained, however, at the Warren Foundry and Pipe Company, where in one of the foundries power-operated jib cranes still serve the casting pits, while in a newer building Niles traveling cranes do similar work. In the case of the jib cranes the product handled is small tubes, and cast-iron pipes from 3 in. to 16 in. in diameter, some flanged and some bell and spigot. The traveling cranes operate in a foundry standardized on cast-iron bell and spigot pipes from 6 in. to 12 in. in diameter. The figures are given in Table 12.

The Crex Patent Column Company use two Shepard Liftabouts in handling columns ranging from 4 in. to 15 in. in diameter and weighing from 100 lbs. to 2 tons. Eight men, from production work, formerly were required to load wagons by hand where two now suffice using the hoist. In addition, seven men under previous methods took a whole day to fill 120 columns with cement, while now they do the work in three hours by aid of a hoist. A total of $20.42 per day, or $6,126 a year, is saved by use of the Liftabouts.

Lumber at the Edward Hines Lumber Company is now moved by use of four Shepard Liftabouts from wagon to planer and back again. Pieces as large as 16 x 16 in. and from 20 to 60 ft. long are handled. From three to eight men were previously required for each piece of timber. The saving in labor by each hoist is equal to one man's work, a total of $14.70 per day, or $4,400 each year.

Paper in 500-lb. boxes, used in ticket manufacture at the Sobar Co., is taken to the second floor by a Shepard Liftabout. Formerly two men took 15 minutes to unload and move a box this distance by elevator, tying up use of the elevator for production processes because 25 boxes arrived at a time. The same work is now done by the hoist at the rate of 3 min. per box, saving $108 a year in labor and saving $2,200 on an investment in a new elevator which would cost $2,500.



From Report of United States Coal Commission

FIG. 1 HAND AND MACHINE LOADING OF MINE CARS

Horizontal sections of curves show times of moving machines; sloping lines, rate of loading including waits for cars.

Loading Machines for Coal Mine Service

The loading of coal on cars in the mines is effectively performed by machine at a vast saving over hand methods. Comparative figures are shown in Fig. 1.

Cupola Charging Machines

A large grey iron foundry, publication of name not permitted, recently installed two cupolas and Whiting pneumatic charging machines, to obtain a melt of 250 tons per day. The use of charging machines enables this tonnage to be obtained from one cupola alone, so that each cupola is now operated on alternate days. The saving in coke, power, labor, and elimination of the night repair gang brought about by use of charging machines amounts to $165.00 per day or $49,500 per year of 300 working days.

Additional comparative data are given in Table 13.

TABLE 13. DATA ON ECONOMIES OF VARIOUS TYPES OF MATERIAL HANDLING EQUIPMENT

Comparisons with hand methods or semi-mechanical equipment given where available. In other cases operating data only are tabulated.

Item	Type of Apparatus	Plant Where Installed and Date	Make	Handling Service for Which Used	Number Used	Loads Handled	Men Required	Men for Hand Methods	Cost of Handling by Equipment	Cost of Handling by Hand	Total Savings by Use of Equipment per Yr.	Additional Advantages Credited
1	Tructractor	M. B. Farrin Lumber Co., 1921*	Clark	Lumber (on trailers) and switching cars	5	1½ to 2 tons per trailer	10	15	$0.125 per 1000 ft. lumber ††	$0.162 per 1000 ft. lumber	$4,646.72	Congestion eliminated. 15 horses eliminated. 71 per cent return on investment
2	"	Riter-Conley Mfg. Co., 1923*	"	Steel (on buggies)	1†	2 to 65 tons total	3	6	$14.20 per day ††	$24.77 per day	2,959 60	Saves $8000 in increased production. Labor turnover greatly reduced. Pays for itself in about 54 days
3	Bucket conveyor	Minneapolis Light Co., 1908	Link-Belt	Coal (up an 80 ft. bluff)	1	225 tons in 9 hrs.	.....	.....	.....	.....	.....	.....
4	Conveyor for assembling	Detroit Vapor Stove Co., 1916	"	Assembling stoves	2	.....	100	200	.....	.....	.....	Increases production Saves 50 per cent of space
5	Locomotivecrane	Sonken-Galamba Iron and Metal Co*	Industrial	Scrap	1 20-T.	300 tons per day	3	.....	$3.50 per hr.	.....	30,000 to 45,000	Big saving in time
6	"	St. Helens Dock and Terminal Co.	"	Lumber	1 20-T.	100,000 to 300,000 ft. in 8 hrs.	5	.....	$0.41 per 1000 ft.	$1.46 per 1000 ft.	41,000	.....
7	"	Dwight P. Robinson Co.	"	Building R. R. freight depot	1 40-T.	.....	50	100	Construction labor $500 per day	Construction labor $1000 per day	18,000 in six weeks	.....
8	"	McKenna Process Co., 1913	"	Rails	.....	500 tons in 11 hrs.	.....	50	$0.05 per ton	.....	.....	Doubles production
9	"	Grand Rapids Malleable Co.	"	Miscellaneous	1 12-T.	.....	.....	.....	.....	.....	13,000	.....
10	"	Grant Iron and Metal Co.	"	Scrap	2 20-T.	400 tons per day	6 (?)	60	.....	.....	.....	.....
11	"	Sewerage Water Board of New Orleans	"	Excavating, filling, handling rails, etc.	1 20-T.	.....	.....	100	.....	.....	.....	.....
12	"	Voth Hardwood Co.	"	Lumber	1 18-T.	225,000 to 250,000 ft. per day	6	.....	.....	.....	.....	.....
13	"	Dempsey Lumber Co	"	Lumber	1 15-T.	100,000 to 250,000 ft. in 8 hrs.	3	.....	.....	.....	.....	.....
14	"	Hubbell Sand Co.	"	Sand	1 20-T.	1300 to 1560 tons per day	6	25 to 30	.....	.....	.....	.....
15	"	U. S. Metals Refining Co., 1905	"	Coal, coke, ores, slag	1 10-T.	45 to 150 tons per day	.....	80 to 100	.....	.....	.....	Increases production 100 per cent
16	"	E. W. Bliss Co., 1916 and 1917*	Brownhoist	Steel, machinery, forgings	1 5-T. 1 10-T.	.....	3	8	3 men 3 hrs.	8 men 1¼ days	Pay for themselves each year	.....
17	"	Winchester Repeating Arms Co., 1915	"	Coal, scrap, switching cars, etc.	1 15-T.	Coal—50 tons in 25 mins. Scrap—1 car per hr. Turnings—1 car in 35 mins.	2	.....	.....	.....	.....	.....
18	"	.....	Link-Belt	Coal, switching cars, etc.	1	12 to 15 cars of coal in 8 hrs.	4	30	.....	.....	Pays for itself each year	Performs big variety of other work
19	Electric hoist	.....	Shepard	Iron and steel	1-floor control	1½ to 10 tons	.....	.....	.....	.....	10,000	.....
20	"	S. Ward Hamilton Pressed Steel Co.	"	Metal pickling	1 Lift-about	12 to 15 tons per day	.....	.....	.....	.....	2,500	Unharmed by acid fumes
21	"	Fried-Lang Leather Co.	"	Leather	1 Lift-about	100 to 1000 lbs.	1	4	.....	.....	2,500	.....
22	"	Paper Manufacturers Co., Inc.	"	Paper	1 Lift-about	500 to 1500 lbs.	.....	.....	.....	.....	1,144	Increased production on one process 66 per cent
23	"	Mercury Mfg. Co.	"	Trailer frames on punch presses	1 Lift-about	.....	2	2	32 secs. per piece	1 min. per piece	480	.....
24	"	School of Industrial Art	"	Ashes	1 Lift-about	2 tons per per day	1	.....	20 mins. per day	4 hrs. per day	400	.....
25	"	Consolidated Ice Co.*	"	Ashes	1 Lift-about	5 tons per day	1	1	1 hr. per day	2 hrs. per day	292	.....
26	"	E. Conran & Sons	"	Pipe and fittings	1 Lift-about	.....	2 or 3	4 to 6	3 hrs.' work, 2 or 3 men	3 days' work, 4 to 6 men	.....	.....
27	Screw-jack locomotive hoist	Railroad shop	Whiting	Unwheeling and wheeling locomotives	1	.....	.....	.....	.....	.....	14,000 to 36,000	.....
28	Cupola charging machine	.....	"	Pig iron and coke	2	110 tons per day	1	5	.....	.....	.....	.....
29	"	Miscellaneous installations	"	"	3 foundries	.....	.....	.....	12½ to 23 cents per ton	.....	Labor of from 2 to 5 men saved in each case	Labor conditions bettered
30	Car dumper	Union Electric Light and Power Co.	Link-Belt	Coal	1	1 car at a time	1	2 or more	Rotary-dump method, 1 man 2 mins.	Bottom-dump method, 2 men 30 mins	.....	.....

*Equipment cost: Items (1) $6500; (2) $16,000; (5 to 15 incl.) $7500 to $15,000; (16) $5000 and $6000; (25) $300. †Item (2) Another purchased recently.
††Total annual operating costs; Items (1) $15,793.93; (2) $3976.

Quality Production From the Application of Automatic Handling Equipment

Labor-Saving Methods of The American Sugar Refining Company

By CLARENCE J. ALFRED

Supervisor of Production, American Sugar Refining Company

Index Number
658.281:664.1 Mechanical handling in sugar refinery

ALONG time ago the popular conception of mechanical methods of turning out goods linked mass production with inferior quality. Today however, few people, and industrial executives least of all, question the fact that the substitution of machine operations for hand labor has had the very opposite effect, raising the grade of workmanship in practically every industry.

The necessity for lowering costs in the manufacture of products, especially in the competitive field occupied by articles of household consumption, has been one important factor in the adoption of mechanical methods, as improvements were worked out, one by one. The increase of demand with the growth of population is a second factor. A third is found in the higher standards of living, which has resulted in more exacting requirements from the trade without a relative increase in prices. Still another factor is the labor situation, with its elements of high wages, and comparative reduction in numbers of men and women available, as new industries have sprung up.

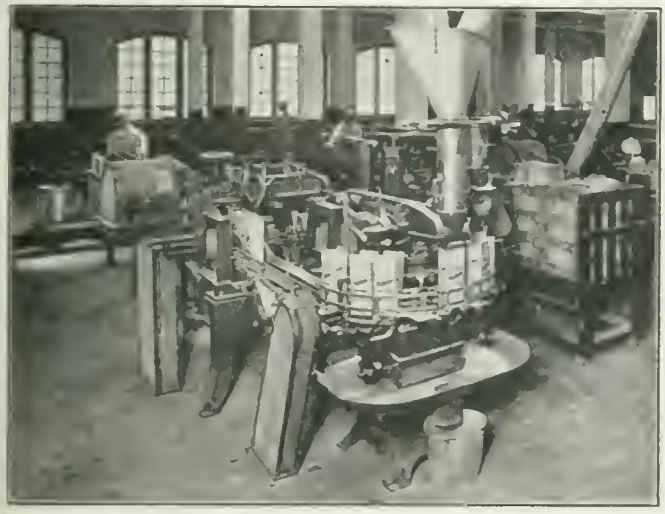


FIG. 1 AUTOMATIC CARTON-FORMING AND FILLING MACHINES

The problem of the American Sugar Refining Company has been to supply a steadily growing demand for Domino Package Sugars, in a manner to assure profitable operation. The company has five refineries in the eastern and southern portions of the United States, in all of which modern improvements have been introduced to insure strictly clean and sanitary methods of production and at the same time reduce costs. The present article describes the handling methods used in the packing departments in one of this company's plants, which is one of the largest of its kind in the world.

In the small package department, Domino Granulated, confectioners, powdered, Old-Fashioned Brown and Yellow sugar is packed. Crystal Domino Tablets, a sugar of the highest quality, is packed in a second department, while the Individually Wrapped Domino Tablets are handled in another section.

Domino granulated sugar is packed in 2 lb., 3½ lb., and 5 lb. cardboard cartons and in 5 lb., 10 lb., and 25 lb. cotton bags. The mechanical equipment employed is of recent development, and has been improved each time experience has pointed out the desirability of a further change in handling methods.

From the last drying operation in the refinery, granulated sugar is delivered to a large conveyor running through the top story of the packing building. An inspector watches the sugar to make sure that uniform quality and pure whiteness are maintained. At regular intervals samples are taken. These samples are combined each day and sent to the superintendent, who thus has direct control over the grade of product.

From the conveyor, sugar is discharged into large storage bins. One man watches this operation and adjusts the dumping mechanism to keep all compartments filled. When the contents are required for packing, a regulating door at the bottom of each bin is opened and set for the correct rate of flow. The sugar then passes over a final screen into the discharge pipe leading to the filling machines.

Handling of Cartons

Cartons, or small boxes, are made from cardboard in the company's own container plant a few blocks away. The cardboard is cut, with a minimum of waste, into the shape of the flattened out boxes, and is scored, printed, folded over, and glued on the seam. The collapsed boxes are then stacked in bundles on special trucks with slatted sides. One side is removable, while the others are stationary. Trucks hold a definite number of cartons of each size.

When loaded, the trucks containing the cartons are run directly onto motor vehicles and delivered to the packing department of the refinery. Freight elevators carry them to the floor where used. Here they are wheeled to the filling machines, and from this point they are handled automatically.

Cartons are stacked in the feeder of each machine. One by one, they are automatically picked up, spread open by a knife, and pushed on a wood block former, the first step in a four-stage process on a circular machine. At the second quarter turn, the inside bottom flaps are folded in. Between the second and the third steps glue is applied and the two outer bottom flaps are pushed in place. In the third position, pressure is applied to seal the bottom. At the fourth stage, a blade pushes the carton from the former onto a chain conveyor, which carries it to the filling machine.

Delivery of cartons to the conveyor occurs at intervals to allow a short space between the boxes as they travel along the guides. At the filling machine they hit a stop, and are pushed, one after another, into the machine. The operation of filling is conducted in stages and takes place as follows. (See Fig. 1).

Method of Filling Domino Cartons

Each carton is first fed under a pipe from which it receives about three-quarters of its full weight of sugar. This sugar comes from the overhead storage bins down pipes, as previously described. The next motion of the machine carries the carton to a second filling point. Here it rests on a scale set to lower when the correct net contents are in the carton. As the box gets in place the sugar begins to discharge into it, but at a slower rate than at the previous station. When the scale goes down, the flow of sugar is shut off. The machine starts again and moves the box along to another part of the conveying system. Here the two inner flaps of the top are folded in, glue is applied, the other flaps are closed, and the box is passed on to the pressure rollers. In passing under these it is firmly

FIG. 2 PACKING FILLED CARTONS INTO CASES

sealed, and continues on its way to the loading bench.

Up to this point the handling has been altogether mechanical. One operator attends to filling the bins, one operator supplies cartons to five filling machines, and one operator watches and adjusts the same five machines to prevent anything going wrong. Stop motions are rigged on each machine which will shut down the particular unit if jamming of cartons or a gap in the supply occurs. Should there be no carton

FIG. 3 STITCHING FIBER-BOARD CASES

ready to enter the filling machine, the machine will not discharge at either station. If jamming occurs in the machine it will stop, and will not pick up any more cartons until relieved. When too many cartons pile up in front of the filling operation the carton forming machine stops. Processes are synchronized, of course, so that shutting down is not an ordinary occurrence.

Packing of the cartons into containers is done by hand. (See Fig. 2). Twenty-five 2 lb., twelve 5 lb., or twenty-four 1 lb. packages, are put into each fiber-board box. The boxes are received at the plant knocked down, and are taken to the floor where used. Here the bottom flaps are closed with copper stitches, on machines for this special work, as shown in Fig. 3. The containers as made are placed on trucks and moved to the packing stands, one of which is fed by each filling machine unit.

The cartons approach, at a rate timed for convenient but continuous packing. A girl, who is seated at the end of the conveyor, attends to the packing and at the same time stamps the container with her number and the date of production. By this means any defective work may be traced back to the unit where it occurred, and the trouble may be corrected. When the container is filled, the operator pushes it onto an inclined roller-conveyor, and it passes to a similar conveyor running lengthwise of the department, on which boxes from all filling stations travel to a spiral chute leading to the sealing floor. Each filling unit handles approximately the same weight of sugar per day. A relief operator substitutes, in turn, for each girl, so that fatigue of workers is eliminated.

Handling of Powdered Sugar

Domino powdered sugar and confectioners' sugar, packed in 1 lb. cartons, are handled in a manner similar to that for granulated sugar. The fineness of the product, however, would cause it to sift from the cartons, and it is necessary to put waxed paper linings in the boxes. This method of packing also protects the contents from atmospheric conditions which would cause

FIG. 4 SEALING CASES AND NAILING BOXES FOR SHIPMENT

the sugar to absorb moisture and become lumpy. Consequently, after the boxes are formed, the machine carries them to an intermediate station. A large roll of waxed paper, mounted on the machine, is cut, folded, pushed into the box, and sealed along the longitudinal joint. This is done from the bottom, the opposite of granulated sugar cartons. The top of the waxed paper lining is neatly interfolded, so that the sugar is fully protected but readily accessible for use.

Before being lined the machine moves the carton under a device which drops a small advertising insert into it. After lining it goes to the filling station. In going from this latter point to the sealer it passes over a shaker which agitates the contents and insures the carton being filled full. The waxed paper lining is next sealed at the bottom, then the cartons themselves are closed and sealed. Packing into containers follows in a manner similar to that for granulated sugar. Powdered sugar is much harder to handle than granulated because it will not flow readily.

Counters on all machines register the daily output. This method insures accuracy and saves a great deal of time and clerical labor.

Maintaining a Check on Weights

A careful check on weights is kept at all times. An inspector of the packing department removes at least one package in every 100 going through each machine, and weighs it to the hundredth of an ounce, to prevent any variation from the full net weight. In addition to this check, an inspector, reporting independently to the weighing department, keeps a record of net weights in the cartons coming from each machine, to make sure that nothing is overlooked.

Containers from the various points of packing are all fed to the main conveyors which discharge them into chutes leading to the lower floor. Sealing is done on this lower floor, one section of which is shown in Fig. 4. The sizes of shipping receptacles vary with the sizes of cartons, whether 1 lb. powdered, or 2 lb., 3½ lb., or 5 lb. granulated sugar packages.

Two girls apply silicate of soda to the inner flaps of the containers as they pass on the final section of conveyors after leaving the chutes. Four helpers, one for each size of box, pick up the approaching cases, and load them on separate platform trucks. They are inverted in the process so that they seal under their own weight. Only one size is placed on each truck. The sugar is then moved to the warehouse floors, and other trucks are brought up to be loaded.

This method of sorting containers and loading trucks is followed to classify products for shipment. Under ordinary conditions sugar moves out of the plant as promptly as produced. A costly rehandling is avoided by leaving the cases on the trucks after loading, later making up trains of trucks, and taking them by large platform elevators and tractors from the intermediate storage floors to the shipping points—to lighters for steamship loading, to car floats for rail transportation, or to motor trucks for local distribution.

Handling of Sugar in Small Bags

Domino 5-lb., 10-lb., and 25-lb. cotton bags are filled by a process quite different from cartons. The method is illustrated in Fig. 5. Granulated sugar from the overhead bins feeds down pipes to the different machines, which are equipped with loading buckets. There are four weighing buckets on each machine for filling 5 lb. bags, three on those filling 10 lb. bags, and two on those for 25 lb. bags. The buckets fill up with the full weight of sugar in each case, and discharge,

FIG. 5 FILLING BAGS WITH DOMINO GRANULATED SUGAR

one after the other, through a spout on each machine. A truckload of sewed and printed bags is located alongside of the operator, who opens and puts them under the spout to catch the successive quantities of sugar. The filling machine has a revolving table which carries the filled bags around to a girl on the opposite side, who runs them through a sewing machine with a

FIG. 6 PACKING BAGS INTO BURLAP SACKS

horizontal needle. A foot lever is used to shut off the sewing machine, when necessary. A hand lever within reach of the girl filling bags enables her to stop the entire mechanism if anything goes wrong.

When sewed, the bags are mechanically pushed off of the circular table by means of a guide, and fed down a chute to a packing table on the floor below, where they are packed in 100 lb. burlap sacks. Fig. 6 shows a view of the packing-room. As these sacks are filled they are loaded on a conveyor paralleling the packing table, and run through a large sewing machine which closes the tops. From this point they are chuted to the warehouse floor, loaded on trucks, and taken to the shipping points.

In many instances Domino sugar in small bags is shipped in barrels. For this method a circular grating, about 2 ft. in diameter, is removed from the packing table. The small bags fall through the opening into a hopper truck beneath, which is replaced by another when filled. The filled trucks are moved into an adjoining room and the bags packed into barrels, the barrels being placed on shakers to settle the contents. Each barrel holds 64 5-lb. bags, 32 10-lb. bags, or 12 25-lb. bags. They are then weighed and headed and are ready for shipment.

Domino sugar in cartons for distant water transportation points, and especially for export trade, is packed in wooden cases instead of fiber-board containers. The boxes are packed in the usual way, and a conveyor discharges them to a spiral chute leading to a lower floor. Here they are switched out of the line of fiber-board boxes and run to a nailing machine. (See Fig. 4). In one operation the lids are nailed on, and then the boxes are wirebound and taken on trucks to the shipping floor. (Fig. 7).

A very interesting and original process, in use solely by The American Sugar Refining Company, is the preparing and packing of Crystal Domino Tablet Sugar. This is a quality product of a pure white color obtained by a high degree of refinement, with particular care to maintain crystalline structure and sparkle. It comes from the refinery in slabs about 15 x 8½ x ⅝ in. in dimension and weighing about 3½ lb.

The slabs are trucked to the packing department, trimmed to size, and sawed and cut into tablet form. The process is designed to preserve the crystalline structure and sparkle obtained by the special methods employed in manufacture. A system of belts and conveyors handles the sugar and carries the empty and filled cartons to and from the packing units. The actual packing of the sugar is by hand. All of the processes, of course, are synchronized to prevent any congestion of work, with provision for shutting off the supply of either sugar or boxes in case of necessity. The boxes are specially dimensioned, 8½ in. long, 5 in. wide, and 1¼ in. deep, to fit the scheme of packing.

After being weighed, the boxes pass registering counters to keep track of the output, and are carried past girls who attach sealing labels, and thence to the loading bench. Here they are packed into fiber-board containers, 30 2-lb. cartons to each case. In the process they are stamped with the packer's number, and with the date. The containers have been set up, stitched, stacked, and trucked to the packing point. When filled, cases are hand sealed and trucked to storage.

Very careful checks on the weight of sugar, quality of work, and economy of operation, are maintained. One inspector in the department takes a percentage of the filled boxes, reweighs them, and records the results. Another inspector, responsible to the head of the weighing department, independently does similar work. No variation from the net 2 lb. is permitted.

FIG. 7 STOREROOM SHOWING VARIETY OF PACKAGES ON TRUCKS

Broken sugar from each unit is collected and weighed on the lower floor. When the amount runs beyond a fixed maximum, based on experience, an investigation is instituted to remove the cause. Powder from the sugar cutting machines is collected by suction, weighed and recorded. Each carton unsuitable for filling is accounted for. These checks eliminate waste.

No figures have been compiled showing the actual savings brought about by substituting mechanical methods for hand processes. It is probable, however, that at least half of the labor cost has been saved.

Wage Incentives and Profit-Sharing

Profitable Methods for the Small Factory—IV[1]

By GEOFFREY C. BROWN

Chief Engineer, Jacques Kahn, Inc.

Index Number
658.32 Wages
658.324 Profit-sharing

As we approach the subject of "wages," we are confronted with two apparent irreconcilables in the divergent viewpoints of the employer on the one hand, and the wage-earner on the other. Should the average small factory employer be asked to provide a suitable definition for wages, he would undoubtedly reply that they are in the nature of a cost feature or liability—something appearing on the wrong side of the ledger, and therefore, in the interest of the business, to be held at a strict minimum. To the workman, however, wages are an asset; his stipulated and only return, not only for the work that he is prepared to deliver, but also, in the words of J. S. Mill—"for all the feelings of a disagreeable kind, all the bodily inconvenience or mental annoyance connected with the employment of his thoughts or muscles, or both". The employer, from time immemorial, has felt a strong personal interest in holding his *wage liability* to the smallest possible figure. The workman has had equally cogent, and possibly more pressing reasons for desiring that his *wage asset* be maintained at a maximum figure.

The conflicting character of these two viewpoints has, in the past, provided cause for nearly all the dissension that has ever occurred between employer and wage-earner. I read recently of a curious old poem, written in the reign of Edward IV, which shows that, in Fifteenth Century England, a system of organized oppression was in full swing, to the disadvantage of the working class. The cloth-makers of the time compelled the workmen to take half their wages in merchandise, which they estimated at higher than its actual value. The poet proposed that "Wyrk folk be payed in good moné," and that an adequate law be passed to that end. According to the account, such a law was passed in the fourth year of Edward IV's reign. The crafts-guilds in the seventeenth and eighteenth centuries, by limiting the number and lengthening the term of apprentices, were able to influence labor supply and demand.

In reviewing industrial relations as they existed in the craftsmanship era, no evidence is found of any attempt to devise a wage system that would operate to the complete satisfaction of employer and wage-earner alike. In a general way, the proprietor's conception of low wages was unsatisfactory to the journeyman, the aspiration of the latter toward high wages was unsatisfactory to the proprietor, and an agreement was only reached after a process of hard individual bargaining, in which the workman, owing to his relative inability to remain idle or to emigrate, was at a very decided disadvantage.

The industrial revolution of the latter part of the eighteenth century, the gradual passing of the craftsmanship era, and the advent of large-scale industry, conduced to destroy the old-time relations between capital and labor. The most interesting and important period in the history of wages is that of the nineteenth and the present centuries, because, numbered among the many industrial developments of this era, has come an attempt scientifically to formulate a new system of wage-payment that will be satisfactory alike to employer and wage-earner, in that it gives to the former a minimum wage cost, and to the latter a maximum wage return.

Day Work Versus Old-Style Piece Rates

The oldest of the wage systems, and the one most commonly found in small factories today, is the day work, or hourly system. This method, involving the payment of a flat rate per hour, has long been regarded by modern management as the least efficient of the wage systems, in that it establishes no connection between pay and performance, and thus provides no incentive to the workman to increase his effectiveness. A common result of the day work system is that the workmen in time succumb to the monotony of their various jobs, their daily effort steadily lessening until a point is ultimately reached when labor cost is so high as to be prohibitive.

Early in the eighteenth century we find attempts to counteract the defects inherent in the day work system, by the institution of wage payment by the piece or unit of output. This system was concerned not at all with providing an incentive in the shape of increased earnings for increased output, but was rather designed to eliminate the idleness or "soldiering" of workmen employed on the day work basis. The piece-work rates were usually based on an old record of past performance, or if, as it frequently happened, no such record was in existence, they were based on either a guess or an opinion held by the employer or by a foreman, as to what constituted a proper day's work. Piece-work rates established in this haphazard way were, obviously, foredoomed to wild inaccuracy. Sometimes they were much too high, in which case they were subjected to a slashing process, this reduction being effected in a manner just as unscientific as that in which the

[1] Preceding articles have appeared in MANAGEMENT AND ADMINISTRATION for February 1924, p. 161; March 1924, p. 305; April 1924, p. 431.

rates had been originally established. More often, though, the rates were too low, the employer being prone to err in a direction favorable to himself. In these latter cases, after the workmen had for a considerable period striven unsuccessfully to earn a fair day's wage, and had suffered privation while doing so, the rates were reluctantly, and often inadequately, increased.

These pioneering attempts to establish piece-work systems, culminated in the "sweat shop" and similar abuses attacked by Kingsley and other Mid-Victorian writers. The condition of the working class during the half-century following the industrial revolution was, on the whole, deplorable, and the term "piece work" has never entirely recovered from the opprobrium which it incurred during the early decades of its use. It is small wonder that the majority of trades unions have, from the start, held the idea of piece work in strict anathema.

These two wage systems, the day work and the old-style form of piece work, are those most commonly encountered in our small industries today. The day work system, with its pristine defects, is used exclusively in the majority of them. The old-style piece rates, where found, while more equitable than those of 50 years ago, are, on account of their unscientific basis, still subject to great inaccuracy.

Wage-Incentive Systems

The application of time study to manufacturing operations, and the accurate determination by this method of proper output standards, have in the past 40 years, wrought a gradual revolution in the industrial attitude toward wage payment. F. W. Taylor's early experiments in the machine shop of the Midvale Steel Company brought to light the fact that workmen employed on the day work basis did not, as a rule, work efficiently, for the reason that has just been set forth. They further revealed that the same workmen, if placed on the old-style or unscientific piece-work basis, devoted a considerable amount of thought to devising ways of curtailing their daily outputs, in order to avoid a reduction in existing piece rates, experience having taught them that such a reduction would probably follow any attempt on their part to speed up. These first time-studies established, beyond question, the fact that workmen could, without discomfort, undue fatigue, or any other ill effect to themselves, increase their efficiency to a point far beyond that which they ever attained under either of the two existing wage systems; also that management itself had but a faint and inadequate conception of the actual productive possibilities of the operations that it was attempting to direct; and finally, that workmen could not be impelled to their best effort by either a verbal order or by the driving methods of a hectoring foreman, but that they must be made to "want to increase their effort" without any coercion. In brief, the process must be rendered largely voluntary on their part.

In order to accomplish this end, Taylor re-established, from his time-study data, new piece-work rates, so computed that they gave to the workman an immediate and substantial increase over his former earnings, if he worked efficiently and followed instructions. He then proved by repeated demonstrations that while the workman's earnings were, in this way, very much increased, his output was likewise increased in such measure that the ultimate labor cost was considerably lessened. In other words, he successfully reconciled the divergent viewpoints of employer and wage-earner by instituting a system of wage payment that gave to the former a minimum wage cost, and to the latter a maximum wage return.

In making a comparison between piece-work rates established in this manner, and those determined in the old, haphazard way, we find that the outstanding characteristic of modern piece-work systems, apart from their scientific basis, lies in the fact that they feature the *incentive* principle. The old-style rates did not possess this quality, and were designed to whip wage-earners into greater activity with a threat of monetary loss if they failed to work at top speed. The modern conception reverses this psychology, substituting a promise for a threat, and for this reason it has proved effectual and a success, where the old system was ineffectual and a failure.

An important phase of the changed attitude toward wage payment is found in the responsibility assumed by modern management for the proper instruction and coaching of workmen until they have learned to work efficiently and earn the higher wage which comes as a reward for greater effectiveness.[2] Under the old-style system of piece work, employees were placed on the piece-work basis, and then left to devise their working methods as best they might. Any time-study observer who has watched the totally different ways in which various workmen perform the same operation, is sensible of the impractical nature of this unsystematic procedure. A piece-work rate in order to be fair, must have a standard time equivalent. This time equivalent, in order to be of value, must accurately sum up the time elements for all constituent suboperations arranged in a definite sequence of performance, plus an adequate percentage time allowance to provide for fatigue. The workman must be shown this sequence, and then patiently coached until he has mastered it.

The Guaranteed Day Work Rate

The practice of guaranteeing to piece workers their day work rates, irrespective of actual performance, may be regarded as the most recent important development in the evolution of wage-incentives. Dr. Taylor's piece-work system, while paying the workman a substantial bonus if he worked in accordance with predetermined time and output standards, is now regarded as having been somewhat severe, in that if a workman did not complete a difficult task within the standard time, he was the loser. Later systems devised by H. L. Gantt, Harrington Emerson and others, eliminate the last vestige of severity from the piece-work idea by giving the workman an advance guarantee that he cannot lose, and that whatever comes, his regular hourly rate is assured.

The writer has found that the psychological effect

[2] See MANAGEMENT AND ADMINISTRATION, April 1924, p. 431.

on workmen of an assured day rate is immense. Knowing in advance that their day work earnings, at least, are secure, they feel no apprehension, and are thus free to concentrate on the mastery of an appointed task. This is of special value with inexperienced or imaginative workmen, upon whom the possibility of failure or loss usually has a demoralizing effect.

CLASS SYMBOL	DESCRIPTION OF WORK	FATIGUE ALLOWANCE PER CENT ABOVE TOTAL TIME	PER CENT BONUS ABOVE DAY WORK RATE OR BASIC RATE FOR SUCCESSFUL TASK ACCOMPLISHMENT
A	Operations requiring little skill, application or hard physical work. *Examples:* Janitor work, routine machine tending, etc.	10-15	25-35
B	Operations requiring little skill but calling for physical strength and endurance. *Examples:* Outside labor, shoveling, piling heavy material, etc.	15-30	35-50
C	Operations requiring considerable skill, and close application, but without hard physical work or undue fatigue. *Examples:* Expert Machine and bench operations.	10-15	50-75
D	Operations requiring skill, close application, and hard physical work. *Examples:* Operating heavy hydraulic presses, steam hammers, heavy wire-drawing machines, etc.	15-30	75 and up

FIG. 14 CLASSIFICATION OF WORK TABLE—SHOWING APPROXIMATE PER CENT FATIGUE ALLOWANCES, AND PER CENT BONUS ABOVE BASIC RATING, FOR VARIOUS KINDS OF WORK

Summarizing, then, the features that should characterize the operation of a modern piece-work or bonus system, we find them to be as follows.

1. The system should be fair to both management and workmen.
2. The piece-work or bonus rates should only be based after careful time-study, and the establishment of accurate time and output standards as outlined in the preceding article.[3]
3. They should be so computed that the workman will earn a substantial increase over his day-work earnings for successful task accomplishment. The minimum bonus should be about 25 per cent of day work rating, and this percentage should range upwards as tasks increase in difficulty, demanding more skill, brains, or hard work in their accomplishment. (Figs. 14 and 15).
4. When a standard task has been prepared and piece-work or bonus rates set, the latter should not be reduced unless some inherent change is made in the details of the task as recorded on the Instruction Card.
5. The planning office and the department foreman should co-operate in coaching backward workmen to the point where they successfully accomplish assigned tasks, and earn the incidental bonus.
6. Workmen should be notified each morning, if possible on a specially printed form (Fig. 15), of their success or failure on the previous day. This slip should indicate the amount of bonus earned.
7. The workman should be assured his equivalent day-work rate whether or not he successfully accomplishes his task. If he is unable, after adequate coaching, to perform a reasonable and accurately set task, it means that he is, for some reason, unsuited to that type of work, and should be transferred to other work.

An additional feature, which may be regarded as optional, is the detail of paying bonus in separate envelopes. This serves to crystallize in the mind of the workman the idea that he has actually received an additional reward for efficient work, and that the extra earnings are available for some hitherto unattainable end, such as the purchase of a home.

The practice of distributing to salaried and hourly rated employees a definite percentage of the earned profits, has of late been receiving considerable attention in current publications. This method is frequently confounded with the various stock-purchase plans adopted and operating today in many of our industries. There is little similarity between the two. A stock purchase plan, in order to encourage thrift, loyalty, and extended service on the part of employees, permits the

(A) INDIVIDUAL BONUS

Time allowed for performance of operation (or task)	27.5 min.
Plus a 10 per cent (variable) fatigue allowance	2.7 min.
Standard time is therefore	30.2 min.
Workman's day work (or basic) rate, per hr	$0.60
Per cent bonus allowed, as per classification	33 1/3 per cent
Standard hourly earnings (day work + bonus) are therefore	$0.80
And standard task rate is $0.80 × 30.2 min. / 60.0 min.	= $0.403

(B) GROUP BONUS

Time allowed for performance of operation (or task)	40.0 min.
Plus a 10 per cent (variable) fatigue allowance	4.0 min.
Standard time is therefore	44.0
Combined day or basic rates (6 workmen) per hr	$4.50
Per cent bonus allowed as per classification	33 1/3 per cent
Standard hourly earnings (day work + bonus)	$6.00
And standard task rate is $6 × 44.0 min. / 60.0 min.	= $4.40

Divided among group in proportion to each man's day work or basic rate

FIG. 15 EXAMPLES SHOWING METHOD OF COMPUTING INDIVIDUAL AND GROUP BONUS TASK RATES

latter to purchase on some favorable basis a certain number of shares in the concern's preferred or common stock; or to buy coupons bearing a fractional value of a single share, which may ultimately accumulate into shares. Profit-sharing, diversely, involves the distribution to employees, without any payment on their part, of a predetermined share of the actual profits, and is designed to develop a spirit of co-operation throughout all ranks, and to stimulate workers to loyalty, greater industry, and long service, by tangibly rendering their prosperity coincident with that of the concern which they are serving.

Profit-sharing is not in any sense a recent development, and its earlier applications in France and England antedate time-study and the wage incentive by

[3] See MANAGEMENT AND ADMINISTRATION, April 1924, p. 431.

several decades. While there is evidence of one or two earlier attempts to introduce this plan, Edmé-Jean Leclaire—founder of the Maison Leclaire, a well-known house painting and decorating establishment in Paris—may for all practical purposes be regarded as the father of profit-sharing. In the year 1840, Leclaire made a careful calculation that each of his workmen, by making a better use of time, could save him 60 centimes a day. He further estimated that the same man could save an additional 25 centimes a day by avoiding waste of materials, and by using tools carefully. He then figured this into a total per year for his working force of 300 men, obtaining as a final result that his workmen could, by increased interest, save him a gross sum of 76,500 francs per year.

He next assembled his workmen and explained the details of a plan by which he proposed to distribute among them a certain percentage of each year's profits, and that as the amount of the dividend would thus be governed by the total amount of profits earned, it was incumbent on all of them to attain a high level of working efficiency. Space will not permit a detailed description of Leclaire's plan, but it included a comprehensive scheme of employees' representation; it is reported as having been successful from its inception; and in 1912, which is the most recent record that I can find, this house, under the name of "Brugniot, Cros et Cie (ancienne Maison Leclaire)," was still operating substantially in accordance with the plan originated by its founder.

Profit-Sharing in England

The idea spread quickly to England and was gradually applied in a number of industries, the most notable application being found in the gas companies, many of which adopted profit-sharing plans in the nineteenth century, and are still operating on this basis. The advent of profit-sharing in England created considerable dissension. John Stuart Mill and Herbert Spencer hailed it as a happy industrial development, while it was viewed in conservative industrial circles, and by most of the labor unions, with open disfavor.

In the United States, the profit-sharing and co-partnership ideas have not developed to the degree that they have in either England or France. The reason advanced by supporters of this principle is that the industrial development of America has been so rapid, and the opportunities for men of ability (with or without capital) so great, that there has been little pretext for much concern about systems of sharing wealth. There have, however, been a considerable number of experiments, and particularly in the past 5 years has there been a strong awakening of interest in employees' representation, profit-sharing, employees' stock purchase and all other movements and plans which together comprise the great general movement frequently termed "the democratization of industry".

The main objections commonly urged against the *principle* of profit-sharing are those that center about its efficacy as an incentive to increased productive efficiency on the part of the individual workman. In our consideration of wage incentives, it was seen that the essence of a modern wage-incentive plan, lies in the fact that it scientifically provides a direct connection between individual performance and individual reward. It is neither collective nor vague, but pays each workman generously for good work, withholding, however, any additional compensation over regular day work earnings, if established productive standards have not been maintained.

A distinct limitation to any profit-sharing plan, judged from the incentive standpoint, lies in the remoteness of its reward. Under a properly managed wage-incentive system, the workman knows not later than the following day how much bonus he earned on the previous day, and each week he receives in a pay envelope, his total bonus for the week. His reward is therefore personal, immediate, and a frequent reminder of the connection between his working efficiency and his compensation. A profit-sharing dividend owing to its lack of connection with individual performance and its remoteness, sacrifices all of these qualities. The tendency of the workman is thus to regard his dividend as an increment to regular day work earnings, coming providentially once, twice, thrice, or oftener during the year, without reference to his personal effort.

It is also urged as an objection to profit-sharing that the efficiency of labor is of minor importance as a factor in profit earning, and that efficient management, which, incidentally, includes the economical use of labor, has vastly greater bearing. This view leads to the corollary that labor, in order rightly to claim a share in profits, must have a voice in management, and this, for a variety of reasons, is not a desirable development. The validity of this objection is not clear to the writer, for reasons that will appear later.

The most cogent objection to profit-sharing is probably found in the fact that it does not bestow a measured reward for a measured increase in the productivity of individual workmen, and from this standpoint cannot, by itself, be regarded as an instrument capable of duplicating the results possible by time-study and the use of a properly worked-out bonus system.

Limitations of Time-Study

Time-study, however, also has its limitations and very obviously can be applied only where operations are measurable from the standpoint of time. While the preponderance of manufacturing operations is so measurable, several important fields of work remain in the outlaw class.

The first of these is the "managerial" field, including all functions of a discretionary character, which directly or indirectly influence the productive potential. These functions, owing to their unmeasurable quality, are usually classified as salaried positions, the salary being a dignified form of time work remuneration comparable to the day work wage basis.

The second important field includes those branches of manufacture where the product is of high quality demanding exceptional skill and indefinitely varying attention on the part of the workmen. Examples are found in the manufacture of jewelry, high-grade mirrors, cabinet-ware, and all similar lines featuring quality in the product, and thus falling definitely within

the small factory classification. The "quality" and "craftsmanship" variables are so numerous in this field, as to render the creation of minute time-constants a virtual impossibility. An important stage in the fabrication of an expensive mirror, for instance, consists of removing every vestige of a scratch or hair line from both surfaces of a plate of glass before it can be backed with silver, and thus transformed into a mirror. In a consignment of 500 such plates, any one of them may be sent to this scratch-polishing operation once, three times, or not at all, depending on the original condition of the plate, as well as on the workman's skill in removing an indefinitely varying number of scratches. Slight variations in the quality of a consignment of raw material may thus be the chief factor influencing time, and this usually lies beyond the control of both management and workmen.

Another type of small factory with operations not readily amenable to close standardization is found in the myriad of electrical and machine repair shops, many of which employ workmen in the hundreds. The work performed in these establishments is largely of a jobbing character, and the similarity between successive jobs, if any exists, is only of a general character. Attempts have been made to standardize these nondescript jobs, by comparing them with previous work sufficiently similar to warrant such comparison. These attempts, however, are little better than guesses, subject always to the inaccuracy which attends any attempt to establish time-standards by intuitive rather than by scientific means.

Field for Profit-Sharing

These three fields—the managerial, that of quality manufacture, and that of the repair shop—are among those to which the principle of time-analysis cannot be applied with sufficient minuteness to render practicable the payment of an incentive based on time-standards. There are a number of others, including the manufacture of soap, perfumery, and the production of gas, etc., which likewise do not respond to this method. The question very properly arises, then, as to what to do with these operations. How will we reward workmen employed in these lines, so that the incentive principle may be kept alive, and they may feel that it is in their interest to work faithfully and efficiently?

They may, on the one hand, be kept on the straight salary or day wage basis, in which case we must depend, as of old, either on initiative inherent in the workmen themselves, or upon the ability of foremen or higher executives to obtain results by force of personality and "percussive" methods. Present-day experience emphasizes the fact that this choice is no longer an adequate one. A more logical inference would seem to be that as we cannot apply a direct wage-incentive to these operations, an indirect incentive similar to profit-sharing should be utilized, and that this plan should then be supplemented by whatever additional measures are necessary to render it effective.

Let us turn briefly to another aspect of profit-sharing, and some of the results claimed for it by those who favor the idea. The writer has, during the past few months, carefully examined numerous profit-sharing plans actually operating today in a great variety of industries. In the majority of these cases, the concerns do not, in reporting results, make much reference to increases in productive efficiency on the part of individual workmen. Several of them make specific mention of the fact that this was not the direct purpose of the plan when it was instituted, but that other more general results were aimed at, and were for the most part attained. Among these may be noted:

1. A considerable reduction in labor-turnover.
2. The elimination of labor trouble and expensive strikes.
3. The awakening of a spirit of co-operation and a new interest throughout all ranks.
4. Evidence of increased thrift, a higher standard of living, and greater contentment among the workmen.
5. In general, a transformed working atmosphere.

The results, briefly, are those which follow the development of an atmosphere favorable to the performance of work. Many of the profit-sharing concerns submit a conviction that with this atmosphere well established, individual results may, in some measure, be taken for granted.

Let us assume, however, that this is not the case and that a profit-sharing distribution will not, of itself, noticeably influence individual productivity. If, notwithstanding, it accomplishes the results just enumerated, wipes out an expensive labor turnover, awakens a spirit of co-operation and a new interest throughout all ranks, eliminates labor trouble and costly holdups in production, and in a general way transforms the working atmosphere; if profit-sharing attains these ends, it must stand as a highly valuable industrial development.[4] With a few exceptions, the concerns using this plan—and there are many such in the United States today—report that some or all of these benefits have directly followed their inauguration of profit-sharing plans.

Profit-Sharing Dividends

The profit-sharing dividends are distributed to participants, sometimes in the form of stock, sometimes as cash, and frequently in some combination of both, that is, part stock and part cash. Some of the plans are assisted by forms of employees' representation, and at least one establishment[5] has included a "Loss-sharing" provision, by which workmen will, during dull periods, make a definite sacrifice, in order to help meet losses if there are any. There is one detail in regard to which all these concerns seem unanimous, and that is, that if a scheme of profit-sharing is to be successful the workmen who participate must be thoroughly trained in the spirit and details of whatever plan is adopted. Just as much care must be given to this aspect as that exercised, say, in the preparation

[4] See "Profit Sharing: Its Principles and Practice," Burritt, Dennison, Heilman, Kendall, Gay; also "Co-partnership and Profit-Sharing," A. Williams.

[5] The A. W. Burritt Co., Bridgeport, Conn.

of instruction cards, and the education of workmen, under a standard task and bonus-incentive plan.

Profit-Sharing in the Jacques Kahn Company

The Jacques Kahn Company manufactures a high quality product, and one that demands superlative craftsmanship at every stage in its fabrication. Most of the workmen mastered the mirror-making art long ago in Europe, they are highly skilled, and have been with the company for many years. In a general way, the business is one in which exceptional quality and fine craftsmanship are primary considerations, while speed of production, though important, must assume a secondary place.

The manufacturing operations are not susceptible to minute time-measurement. The writer, backed by years of time-study experience, has gradually realized the futility of attempting to reduce an infinite number of "quality" variables to time-constants, and also that in order to apply an incentive to these operations, some other basis than that of time must be found.

This business, during the past 10 years, has suffered from the effects of three disastrous strikes. An examination of causes brings to light the fact that all three might have been avoided had the management displayed a little more disposition to confer with the workmen; and had the workmen shown a trifle more patience in endeavoring to secure a fair compromise by pacific means. *In studying the immediate results in each case, one is forced to the conclusion that neither management nor workmen gained a single advantage that might not have been secured at much less cost had each been prepared to submit the various issues to a process of friendly discussion and compromise.* In brief, these three strikes came as the direct result of a lack of mutual understanding and confidence, and an apparent divergence of interest between management and workmen.

For the past 5 years the Jacques Kahn Company has made use of a limited form of profit-sharing, involving the distribution to certain purely managerial functions of a stipulated percentage of the annual earned profits. The directorate now have under consideration a plan by which this distribution will be so extended as to include as participants, all workmen who have been in the concern's employ for 12 consecutive months prior to the date of each distribution. Space will not permit a complete presentation of this plan. It may be stated, however, that it is conservative in character, and that no profit-sharing dividend will be declared until adequate reserves have first been set aside to provide for such exigencies as uncollectible accounts, income tax payment, and normal expansion of the business. With these and other contingencies provided for, the remaining balance of profits will, in conformity with the plan, be distributed in proportions of 20 per cent to wage-earners (classification A) 20 per cent to management (classification B) and 60 per cent to the company's shareholders (classification C). Dividends to wage-earners will be distributed in proportion to wage rates, but will in no sense be regarded as wages, the latter being maintained at the prevailing union scale.

Administration of the business as a whole will, as formerly, be in the hands of a board of directors representing, and elected by, the stockholders. At monthly meetings, upon examination of the regular monthly statement, this board will decide on the proper balance available for distribution, after deducting the beforementioned reserves. A managerial committee, consisting of three members representing the management, and three members elected by the workmen, will meet monthly to discuss matters bearing on efficient management of the factory, and to establish suitable dates for the distribution of profits in classification A. The dividends to workmen will, as far as possible, be declared monthly, and as the company has a thoroughly modern cost system, there is no impracticability in such frequent payments.

Advantages of the Managerial Committee

The detail of a managerial committee consisting of representatives from both management and workmen brings us to the frequently urged objection that wage-earners in order rightly to claim a share in profits, must have a voice in management, and that this is not a desirable development. The writer earlier declared himself at variance with this view. Reading the signs of the times aright, it seems obvious that the old-style militaristic manager and militaristic foreman, will soon be just about as anachronistic as are now the old wooden Indians that used to stand solemn guard in front of our cigar stores. The old idea of keeping workmen in the dark as to all details of management is passing. The conference table is today a highly important managerial adjunct, and an increasing number of questions, formerly controversial in character, are now settled in this way quite as a matter of course. Any development which makes for mutual understanding and an intelligently concerted effort on the part of management and workmen, is desirable. If the latter are not sufficiently enlightened to share somewhat in management, and occasionally send representatives to conferences for the discussion of questions affecting their work and themselves, it is incumbent on management quickly to assume responsibility for training them to acquire this enlightenment.

Conclusions

In conclusion, where manufacturing operations are of such a character that they may be readily time-studied and exact time-standards thus established, there is little question about the superiority of a wage-incentive based in this way. It rewards individual results, is simple in operation, and if properly calculated, is eminently fair alike to management and workmen. It is the scientific way and the right way. Where operations are not susceptible to such close time measurement, and where better industrial relations and a transformed working atmosphere are needed, a more indirect form of incentive similar to profit-sharing must perforce be employed. When modern management has discovered ways of more closely standardizing these operations, the more exact method can be utilized.

(To be continued in the June issue.)

Foreign Trade in Relation to Industry

Economic Problems of Industrial Organization—IV[1]

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IT is a commonplace that commercial ties between nations have been immeasurably strengthened with the development of the modern type of industrial organization. A division of labor between sections of the earth similar in many ways to the technical division of labor within a factory has naturally resulted from the uneven distribution of the raw materials of industry and of population, and from differences in the natural aptitudes of races. No country today is completely self-sufficient economically, though some may approach this more closely than others.

The difficulties of the American farmer during the last several years, taken in connection with the condition of Europe, illustrate the far-reaching effects of industrial disorganization in any important region, as England's struggles against the submarine blockade during the war showed how vital was the maintenance of open trade routes. The United States is less dependent upon her foreign trade than England, yet the development of our trade is affecting the constitution of our economic system, is determining the character of our industries, and is shaping our economic and political interests abroad.

The problem of our economic relations with the rest of the world is of particular interest today, because these relations have been fundamentally altered by the events of the past 10 years. An understanding of the principles of international trade, and of the changes in the trade relations of the United States which the war and its aftermath have brought, is essential to an intelligent approach to most of the major economic problems of the day. A preliminary discussion of the factors determining the character of the country's imports and exports will explain the basis of international trade.

The Law of Comparative Costs

What is called the "law of comparative costs" lies at the foundation of international trade, as it lies, in fact, at the base of all trade. This law is merely a statement of the fact that trade between nations depends not on absolute costs but on comparative or relative costs of production. It is quite obvious that if nation A can produce a certain quantity of wheat (say *a* bushels) by 30 days' labor, and a certain quantity of steel (say *b* tons) by 50 days' labor, while nation B produces the same quantities by 50 and 45 days' labor, respectively, trade between the two will be mutually advantageous. For, if *a* bushels of wheat exchange for *b* tons of steel, nation A, by concentrating on wheat, can procure the given quantities of the two commodities for 60 instead of 80 days' labor and nation B, concentrating on steel, can procure the same quantities for 90 instead of 95 days' labor. Here there is an absolute difference in favor of nation A for wheat and in favor of nation B for steel. It is perhaps not so obvious that trade will be mutually advantageous even if one nation has an absolute advantage in the production of both wheat and steel, as in the following example:

	Nation A	*Nation B*
a bushels of wheat cost	30 days' labor	60 days' labor
b tons of steel cost	40 days' labor	45 days' labor

If there be no trade between these two countries, nation A will produce the given quantities of the two commodities at a total cost of 70 days' labor, and nation B will do the same at a cost of 105 days' labor. If there be trade between the two, *a* bushels of wheat exchanging for *b* tons of steel, nation A, specializing on wheat, can secure the two commodities for 60 days' labor and nation B concentrating on steel can secure the two for 90 days' labor. Nation A has an absolute advantage in the production of both commodities, yet it is to its advantage on purely economic grounds to import steel. It gains by the equivalent of 10 days' labor by this exchange, while nation B gains by the equivalent of 15 days' labor.

This, in simplified form, is the explanation of all trade, domestic as well as international. It is the comparative rather than the absolute cost which determines the nature of a country's product and the flow of trade. Thus it is conceivable that a lawyer might be able to operate a typewriter more efficiently than his stenographer could, but he would not for that reason undertake the task to the exclusion of preparing briefs and arguing cases. His comparative efficiency is greatest in the latter field. In the same way a nation tends to specialize in the production of those commodities in which its comparative advantage is greatest. Non-economic factors, such as the desire for military strength, may prevent such specialization, but always at a loss of economic efficiency.

The actual adjustment of this international division of labor and exchange is effected through the medium of prices; monetary costs and the opportunity for

[1] Preceding articles have appeared in MANAGEMENT AND ADMINISTRATION for February 1924, p. 215; March 1924, p. 337; and April 1924, p. 423.

pecuniary profits are the immediately guiding factors in production and exchange. The relations between costs described in the above example are reflected in prices and in the opportunity for profits, before affecting active trade, but the train of events by which this is accomplished need not be detailed. It is essential, however, to understand the means by which payments are made in international trade and the nature of the chief factors entering into these payments.

The Balance of Trade

Exports must pay for imports, of course. No country can permanently buy more than it sells, or sell more than it buys, so, except for temporary fluctuations, exports and imports must balance. This does not mean that merchandise imports must equal merchandise exports, for many "invisible" items enter into the balance. The failure to take account of these "invisible" items has led to a rather misleading conception of favorable and unfavorable balances of trade.

The balance of trade is considered to be favorable when merchandise exports exceed merchandise imports, for when this is true a country appears to be selling more than it is buying, and therefore enriching itself. In the reverse case, when imports exceed exports, the condition is considered unfavorable because there appear to be larger purchases than sales. Actually, of course, exports and imports of material goods constitute only a part of the credit and debit items which enter into a country's international balance sheet. A country must pay for services rendered by foreign shipping and by foreign insurance companies; immigrant remittances and the expenditures of tourists constitute definite debits or credits. More important are loans of capital and extensions of credit, together with interest payments on such loans and the repayment of the principal. The total debit and credit items on a country's balance sheet must balance, but these factors, which are invisible in so far as the summary of merchandise trade is concerned, constitute just as definite parts of the total as items based upon material goods. The presence of these factors in a nation's balance sheet, either as debits or credits, has an important bearing upon the character of a country's industries. More accurately, the character and degree of a country's economic development are reflected in the balance sheet which shows its international debits and credits. These points cannot be better illustrated than by a brief review of the changes which have taken place in the trade relations of the United States in the last half-century, a review which will furnish the background for a discussion of the situation resulting from the trade revolution which the war brought about.

Pre-War Trade Relations of the United States

Prior to 1873 the annual merchandise imports of the United States exceeded merchandise exports by a small amount. That is, invisible credit items slightly exceeded invisible debit items. The most important of these credit factors during the first three-quarters of the nineteenth century was the foreign capital being invested in this country. Railroads were being built, public works constructed and industrial plants erected, and the capital accumulations of a young nation were insufficient to meet these requirements. These foreign loans actually came as concrete goods: steel rails, structural steel, and industrial equipment of all sorts. The excess of imports thus represented a foreign debt which was constantly piling up.

The year 1873 marked a definite transition in our trade relations with the world, the beginning of a new period which lasted until 1914. Between these two dates annual merchandise exports exceeded imports; that is, invisible debit items exceeded invisible credit items, and the balance was made up by payments in the form of goods. There was no halt to the inflow of foreign capital during this period, but these loans were more than counterbalanced by payments due abroad. These payments consisted of interest charges on foreign loans, expenditures of American tourists in foreign lands, immigrant remittances and payments for insurance and freight services. By the last pre-war year the interest charges we owed abroad amounted annually to about 200 millions of dollars, immigrant remittances and expenditures of American tourists each came to about 150 millions of dollars, and payment to foreign freight carriers and insurance companies amounted to about 25 millions annually. By that year the annual capital imports from abroad had dwindled to a sum quite small in comparison with these items, so that, when our export of capital for investment abroad was taken into account, our net annual debits, in so far as invisible items went, amounted to about 500 millions of dollars. Gold imports and exports about balanced each other. The invisible debt balance was paid in goods, so that at this time the surplus of exports amounted to about 500 millions annually. We had to pay more in goods than we received, a condition commonly and misleadingly described as a favorable balance of trade.

Trade Relations During the War

The war ushered in a period marked by an enormous increase in the surplus of exports, though the factors responsible for this condition were quite different from those of the pre-war period. In 1919, when this excess of exports reached its maximum, it amounted to 4168 millions of dollars. These tremendous shipments of goods were balanced in part by the return of American securities owned abroad, but the greater proportion represented public and private loans made by this country to the allied nations. In the course of 8 years there was affected a fundamental transition in our trade relations with the rest of the world. Before the war we were a debtor nation to the amount of at least 4000 millions of dollars, representing European capital invested in this country. No less than 3000 millions of this debt were extinguished by the return of securities, and in addition public and private credit extensions of about 12,000 millions of dollars were made. Overnight, almost, the United States became the leading creditor nation of the world. The effects of this sudden transition upon domestic and international industrial arrangements and trade channels are being felt already, though their full significance will not be appreciated until international economic relations have

again reached a condition of equilibrium. Some of the most important effects, in so far as the United States is concerned, may be suggested.

The war left the United States in an economic condition distinctly different, in at least three respects, from that existing prior to it.

1. We changed from a debtor nation, to a net amount of about 4000 millions of dollars, to a creditor nation, to a net amount of at least 12,000 millions.

2. Our gold holdings increased by more than 1000 millions of dollars, amounting to approximately three billions of dollars at the end of the war. These stocks have been increased still further since 1918, until at present the United States holds something more than one-third of the world's free gold.

3. The war brought about a distinct change in our relative position with respect to the accumulation and use of capital. Our powers of capital accumulation were undoubtedly enhanced, partly through the stimulus to saving which the war years gave, and partly because the productivity of industry in general was somewhat increased by the war. At least part of this gain has been held. More important with respect to our relative position is the fact of tremendous destruction of capital abroad, while America's internal needs have not materially increased. Before the war the net movement of capital (excluding interest payments and repayments of loans) was into this country. It is certain that in the future the net movement of capital (again excluding interest and debt payments) will be out of this country. This will be due not only to loans to Europe, but also because loans to the colonies and developing regions of the earth will be made by American investors to a greater extent than formerly.

The effect of these changes on our future trade relations cannot be exactly estimated, but certain general tendencies are clear. The invisible items entering into our future trade balances will be fundamentally different from those which prevailed before the war, and this difference will, of course, be reflected in alterations in the balance of material goods.

Any attempt to evaluate these "invisible" factors introduces a considerable element of uncertainty when the war debts are dealt with. The following statement presents the official war debts as they stood on May 31, 1923.

Obligations of foreign governments, under authority of acts approved April 24, 1917, and September 24, 1917, as amended, were:

Belgium	$347,210,808.68
Cuba	7,354,500.00
Czechoslovakia	61,974,041.10
France	2,933,265,231.96
Great Britain	4,105,318,358.44
Greece	15,000,000.00
Italy	1,648,015,970.00
Liberia	26,000.00
Rumania	23,205,819.52
Russia	187,729,750.00
Serbia	26,125,467.05
Total	$9,355,225,947.65

In addition to these governmental debts there are probably outstanding at the present time approximately 2500 millions of dollars in the form of private investments abroad. Of the public debts definite arrangements for the payment of interest and the repayment of principal have been made only by Great Britain. On the assumption that similar arrangements will be made for the repayment of the other public debts, the invisible items, apart from future capital investments or repayments of principal of debts, may be estimated at the following annual values:[2]

Credit		*Debit*	
Interest	$550,000,000	Immigrant remittances	$200,000,000
Freight	15,000,000	Tourists' expenditures	200,000,000
		Interest	100,000,000
		Insurance	15,000,000
Total	$565,000,000		$515,000,000

Since the excess of annual credits in our favor will be paid in goods (gold being out of the question, for we already hold more than we can expect to retain permanently) these figures would lead us to expect an annual excess of merchandise imports amounting in value to 50 millions of dollars. But other factors will enter. Our excess of gold holdings must be returned sooner or later, when the continental countries begin to re-establish their currencies upon a gold basis, and this export of gold will be paid for by importations of merchandise. If the bullion were sent abroad in the form of a gold loan for the purpose of rehabilitating European currencies, immediate payment in goods would not be received, but this would merely swell the amount due us eventually. The whole situation, again, will be affected by the degree to which we invest new capital abroad. The export of capital appears concretely in the form of merchandise exports, and it is conceivable that this process might counterbalance the other factors enumerated. There will undoubtedly be a greater outflow of capital than before the war, but such a process, by swelling the amount of interest due us, serves ultimately to increase merchandise imports. So, even granting the probability of continued heavy capital investments abroad, it would still appear that, in the long run, our balance of trade will be "unfavorable," in the sense that merchandise imports will exceed exports. (This statement is made on the assumption that there will be no wholesale cancellation of foreign debts.)

It was obvious at the end of the war that this revolution in our trade relations was inevitable. The balance of exports, which reached its maximum in 1919,

[2] In making these estimates no allowance has been made for payments in connection with relief work or other exceptional items which have affected the trade balance during the past four years. Thus for the year 1922 the Department of Commerce estimated that immigrant remittances plus expenditures for relief amounted to 400 millions of dollars, while a similar estimate for 1920 amounted to 700 millions. The estimates given above relate to normal conditions.

when it amounted to 4168 millions of dollars, remained high in 1920 and 1921, amounting in 1920 to 2976 millions and in 1921 to 1965 millions. The year 1922 witnessed a beginning of the movement toward more normal relations, when the excess of exports fell to 754 millions; in the fiscal year ending June 30, 1923, the excess of exports was only 176 millions of dollars, the smallest since 1896. Barring unforeseen developments this tendency will continue, but a possible excess of merchandise imports, creating an "unfavorable" balance of trade, may not be an unhealthy condition.

Changes in the Exports and Imports of the United States

During practically the whole of the nineteenth century the outgoing trade of the United States consisted primarily of foodstuffs, food animals, and crude materials for use in manufacturing. In 1860, 87 per cent of all exports consisted of raw materials, while manufactured goods constituted but 13 per cent of the total, by value. In 1899 raw materials comprised 72 per cent, while manufactured goods made up 28 per cent of the total. The tendency revealed by these figures has continued in an even more pronounced form during the first quarter of the present century. Foodstuffs and raw materials of all sorts have been declining in relative importance, while exports of manufactured and semi-manufactured goods have been constantly gaining. By 1910 manufactured and semi-manufactured goods, including partly or wholly manufactured foodstuffs, comprised 60 per cent of the total exports by value. The process was somewhat interrupted by the war, which swelled our exports of raw foodstuffs, but the tendency toward a diminution of our exports of raw materials and an increase in exports of manufactured goods has been clearly apparent in recent trade figures. In the fiscal year ending June 30, 1923, merchandise exports, by value, were distributed as follows:

	1923 Per Cent
Foodstuffs	10.2
Crude Materials	26.2
Manufactured and semi-manufactured goods	63.6

A corresponding change has been taking place in the character of our imports. In the early years of our national existence we were, of course, dependent upon the older industrial countries for a large part of our manufactured goods. In 1821 manufactured and semi-manufactured goods, including manufactured foodstuffs, constituted 84 per cent of merchandise imports by value, and raw materials for use in manufacture made up 4 per cent of the total. Raw foodstuffs and food animals constituted the remaining 12 per cent. By 1880 the figure for manufactured goods had fallen to 63 per cent, while raw materials had increased to 20 per cent. In 1910 manufactured and semi-manufactured goods made up 54 per cent of the total, raw materials 36 per cent, and raw foodstuffs 10 per cent. In 1923 the relations between these various import groups were as follows:

	1923 Per Cent
Foodstuffs	9.4
Crude materials	39.1
Manufactured and semi-manufactured goods	51.5

This transformation has not been a sudden one, yet the change in our trade relations with Europe, resulting from the liquidation of old debts and the piling up of enormous obligations to us, bears most directly upon the problems due to the former cause. For, in view of the gold situation, these debts must be paid in goods, and the character of the goods which shall be sent in payment is a matter of some concern to us.

It is impossible to say precisely how the working out of the economic processes which enable the debts to be paid will affect the tendencies already in operation. Payment by means of manufactured and semi-manufactured goods would probably be most convenient for the established industrial countries which are our chief debtors, but our tariff policy has been definitely framed to prevent this. While part of the surplus of imports which will represent the debt payments will undoubtedly consist of manufactured goods, the chief payment may have to be effected through the importation of crude materials for use in manufacture.

The growing importance of manufactured goods in our export trade raises problems of immediate concern to individual exporters, problems connected with the process of marketing abroad. When our exports were composed primarily of raw materials for manufacture we were dealing with buyers abroad whose needs were not specialized, who wished cattle, leather, wheat or cotton, preferably standardized, but of a general type. Salesmanship played a minor part in the process, and accordingly the simplest selling organization sufficed.

The situation is quite different when specialized manufactured products—razors, cloth, sewing machines, tractors, automobiles—are being sold abroad. Definite and unique needs are to be met, and they cannot be met unless there is full knowledge on the part of the seller of the nature of the demand. Perhaps even more important than this problem of understanding and meeting distinctive and special needs is that of creating a market, and arousing a demand for specialized products. All this means that under the new conditions the arts of salesmanship are much more essential to successful selling in foreign markets than they were when the great volume of our export trade consisted of foodstuffs and raw materials. Competition of a type never encountered under old conditions is being met in the new markets we are invading, and American sellers must shape their selling policies and methods accordingly. Careful study of demand, manufacture for specific needs, efficient selling organization, and the adoption of terms of sale which are adapted as closely as possible to the business habits of our foreign customers—these must be cardinal principles in the export trade of the future.

(To be continued in the June issue.)

Pipe Specifications and Bills of Material

Management Data Summary—Number 26*

By HUBERT E. COLLINS

Mechanical Engineer

Index Number

621.774 Pipe specifications

WHEN boilers, reciprocating or turbine steam engines, internal combustion prime-movers, generators, or motors are desired, they are specified in all detail by the manufacturer. The intending purchaser need only indicate type, pressure, and horsepower of boilers or steam engines; horsepower of internal combustion prime-movers; type, voltage, kva, amperes, or horsepower of generators or motors; and he will receive a complete description with the price of the proposed equipment. So it is with the auxiliaries such as heaters, pumps, condensers, etc. But it is not so with minor equipment such as piping and insulation, and it is the purpose of the writer to point out how best to take care of these in specifications.

A collection of separate specifications or bills of material for boilers, engines, generators, motors, heaters, pumps, condensers, and piping with insulation can be put together into one contract. In fact, they are so considered when included with the general terms of a contract specification. In this way, specifications with drawings constitute a contract.

Bills of Material

In writing bills of material for estimate or ordering, the first requisite is to know what is wanted, and then to detail it clearly. If these two essentials are complied with, the manufacturer, to whom the buyer for the owner or superintendent submits the bill of material can give a correct estimate.

It generally falls to the engineer to write his own specifications or bills of material. They go first to the owner or superintendent as a requisition. Either one or the other of these will turn them over to the buyer for estimate or to order. They should be so clear that the manufacturer can estimate or fill the order without loss of time in writing back for missing detail, and explicit enough to become part of a contract. It should be possible for the receiving clerk for the purchaser to use his copy to check receipt of goods from the manufacturer.

Then, again, a copy of the bills of material turned over to a foreman with written instructions should be all that is required for him to go ahead with any work on hand using the material called for, or, if part of a contract, can be used in the same way by the contractor.

Tables of pipe sizes are given in any well-known engineers' handbook, or in the catalogues of the tube (pipe) manufacturers, as well as in the publications of supply houses.

All pipe under 3 in. size is furnished in "random lengths" from 12 or 15 ft. to 20 ft. When pipe desired is under the random length it is "cut to order". Cut to order pipe must be specified as to length in feet and inches, with the statement as to whether it means end-to-end or center-to-center dimensions. Center-to-center means threads cut on each end of the length to make up on standard fittings to bring them to the quoted length, on their centers. Cut-to-order pipe has plain ends unless otherwise specified. It should be made clear if threads are desired on one or both ends. The best way is to send a sketch with the order. An extra charge will be made for cutting and threading pipe over 3 in. in diameter.

If pipe is to be delivered with threads undamaged, "couplings to come on threads" must be specified. If the pipe is over 3 in. in size, half-couplings (called protectors) are used and here specify "protectors with threads".

Odd sizes above 6 in. are special, such as 7, 9, and 11 in. All special sizes cost extra. All sizes to and including 12 in. are inside diameters and the threads on the ends should be cut according to the lengths given in Table 1.

TABLE 1 LENGTH OF THREAD ON PIPE[1]

Pipe Size In.	Length of Thread—In.	Pipe Size In.	Length of Thread—In.
$\frac{1}{8}$	$\frac{1}{4}$	$3\frac{1}{2}$	$1\frac{1}{16}$
$\frac{1}{4}$	$\frac{3}{4}$	4	$1\frac{1}{16}$
$\frac{3}{8}$	$\frac{3}{4}$	$4\frac{1}{2}$	$1\frac{1}{4}$
$\frac{1}{2}$	$\frac{7}{8}$	5	$1\frac{1}{16}$
$\frac{3}{4}$	$\frac{7}{8}$	6	$1\frac{1}{4}$
1	1	7	$1\frac{1}{4}$
$1\frac{1}{4}$	$1\frac{1}{16}$	8	$1\frac{1}{16}$
$1\frac{1}{2}$	$1\frac{1}{16}$	9	$1\frac{3}{4}$
2	$1\frac{1}{16}$	10	$1\frac{1}{2}$
$2\frac{1}{2}$	$1\frac{1}{16}$	12	$1\frac{3}{4}$
3	1		

[1] When properly cut, the threads should make up in valves or fittings to the distance given in this table and still show one or two threads on the outside.

Above 12 in., all pipe sizes give outside diameter (*OD*), and the thickness should be specified, or weight given. This size pipe will come "plain ends" unless otherwise specified. If threads are desired, specify "threaded" on one or both ends.

After the quantity and size of pipe is given in the bill of material, the kind and quality desired must be specified.

Wrought iron is the least susceptible to the corrosive

* This article is one of a series which gives in concise, factual form standardized methods and accepted practice generally applicable in industrial operations.

action of distilled water and certain acids, while steel has the greater tensile strength. Steel has been considered by some to be harder and more brittle than wrought-iron, but this has come from the workmen using the wrong dies for cutting threads. A die for wrought-iron threads does not have the cutting edge at the right angle for use on steel pipe. To use a wrought-iron die on steel soon results in stripped threads, making it appear that the steel is hard and brittle when it is not.

After settling which quality is desired, specify wrought-iron or steel. Wrought-iron can be abbreviated to (w. i.) Lap-weld pipe is stronger than butt-weld pipe. Specify which is desired. Both wrought-iron and steel pipe can be secured galvanized, and if desired, must be so specified.

As to weight of pipe there is a great diversity with as many standards as there are manufacturers. Some of the following are offered—full weight, standard weight, manufacturers' standard, Byers' standard, extra heavy, manufacturers' extra heavy, Byers' extra heavy, double extra heavy, manufacturers' double extra heavy, Byers' double extra heavy, and others.

TABLE 2. PIPE WEIGHTS[1]
(Wrought-Iron, Steel)

STANDARD WEIGHTS

PIPE SIZE—IN.	WEIGHT PER FT. LENGTH
1/8	0.245
1/4	0.425
3/8	0.568
1/2	0.852
3/4	1.134
1	1.684
1 1/4	2.281
1 1/2	2.731
2	3.678
2 1/2	5.819
3	7.616
3 1/2	9.202
4	10.889
4 1/2	12.642
5	14.810
6	19.185
7	23.769
8	25.000
8	28.809
9	34.188
10	32.000
10	35.000
10	41.132
11	46.247
12	45.000
12	50 706

EXTRA HEAVY WEIGHTS

PIPE SIZE—IN.	WEIGHT PER FT. LENGTH
1/8	0.314
1/4	0.535
3/8	0.738
1/2	1.087
3/4	1.473
1	2.171
1 1/4	2.996
1 1/2	3.631
2	5.022
2 1/2	7.661
3	10.252
3 1/2	12.505
4	14.983
4 1/2	17.611
5	20.778
6	28.573
7	38.048
8	43.388
9	48.728
10	54.735
11	60.075
12	65.415

TABLE 2. PIPE WEIGHTS (*Continued*)

DOUBLE EXTRA STRONG WEIGHTS

PIPE SIZE—IN.	WEIGHT PER FT. LENGTH
1/2	1.714
3/4	2.440
1	3.659
1 1/4	5.214
1 1/2	6.408
2	9.029
2 1/2	13.695
3	18.583
3 1/2	22.850
4	27.541
4 1/2	32.530
5	38.552
6	53.160
7	63.079
8	72.424

LARGE PIPE SIZES

O D	THICKNESSES—IN.								
	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	1
	INSIDE DIAMETERS—IN.								
14	13 1/2	13 3/8	13 1/4	13 1/8	13	12 7/8	12 3/4	12 1/2	12
15	14 1/2	14 3/8	14 1/4	14 1/8	14	13 7/8	13 3/4	13 1/2	13
16	15 1/2	15 3/8	15 1/4	15 1/8	15	14 7/8	14 3/4	14 1/2	14
17	16 1/2	16 3/8	16 1/4	16 1/8	16	15 7/8	15 3/4	15 1/2	15
18	17 1/2	17 3/8	17 1/4	17 1/8	17	16 7/8	16 3/4	16 1/2	16
20	.	19 3/8	19 1/4	19 1/8	19	18 7/8	18 3/4	18 1/2	18
22		21 3/8	21 1/4	21 1/8	21	20 7/8	20 3/4	20 1/2	.....
24		...	23 1/4	23 1/8	23	22 7/8	22 3/4	22 1/2	.....
26		...	25 1/4	25 1/8	25	24 7/8	24 3/4	24 1/2	.....
28	..	...	. .	27 1/8	27	26 7/8	26 3/4	26 1/2	.....
30	. ....	.....	.....	29 1/8	29	28 7/8	28 3/4	28 1/2	.....

[1] Pipe over 12 in. in diameter should be ordered by thickness, instead of weight, keeping in mind the internal diameters, as shown on the table.

TABLE 3. SEAMLESS BRASS TUBING (PIPE) WEIGHTS

PIPE SIZE—IN.	WEIGHT PER FT. LENGTH
1/8	0.25
1/4	0.43
3/8	0.62
1/2	0.90
3/4	1.25
1	1.70
1 1/4	2.50
1 1/2	3.00
2	4.00
2 1/2	5.75
3	8.30
3 1/2	10.90
4	12.70
4 1/2	13.90
5	15.75
6	18.31
7	26.28
8	29.88

This applies to both wrought-iron and steel pipes, and is very confusing to the purchaser. It is also annoying to order pipe with a certain weight in mind, and find on delivery that a lighter weight has been received. The only way to avoid this confusion and annoyance is to specify a weight per ft. which is taken from the accepted standards of the Joint Committee on International Standard Pipe Threads of the American Society of Mechanical Engineers.

Table 2 is compiled from the work of this Committee and is approved by the Society.

Brass and copper pipe is made up to thread the same as wrought-iron or steel pipe, so that iron fittings can be used if desired. In ordering brass pipe, use the

weights given in Table 3. Add 5 per cent to the weights given when ordering copper pipe.

Wrought-Iron and Steel Pipe Bends

The use of expansion loops (bends), offsets, right-angled turns, and similar devices, provide for flexibility of contraction and expansion in pipe lines, resulting from temperature changes. They are preferable in most cases to the use of slip-joints, or corrugated copper expansion joints.

Bends of different types are shown in Figs. 1 and 2. Some one of these will be found to fit the needs in the majority of cases, and after the type is decided on, a sketch of it should be made to accompany the bill of material order, with each dimension specified.

The letters given on the cuts in Figs. 1 and 2 are as follows:

R—is the minimum radius allowable for the size.
T—is the minimum distance of the straight runs.

Other letters indicate ordinary dimensions.

The thickness of pipe for bends should be carefully considered, owing to scaling in heating and thinning of the wall due to stretching in the bending process. A reference to Table 4 will act as guide in this matter.

With the foregoing knowledge of the thickness of pipe for bends, a knowledge of the allowable minimum dimensions is given in Table 5.

It is also desirable to know the amount of expansion taken care of by pipe bends and this is shown in Table 6.

At this point in the consideration of the use of pipe bends, it is desirable to know the amount of expansion to be expected in a straight line pipe and for that purpose Table 7 can be used.

Specify pipe bends, as per sketch (which gives size and dimensions) adding quality, and weight, to the written bill of material. To it should be added the following specification:

This bend is to be free from buckles and blisters, practically circular in cross-section, bent before being threaded or flanged, and where flanged refaced true to dimensions, so that they may be bolted in place without forcing. Bends to have tangents at each end for threading or flanging as shown in dimension T, Table 5.

TABLE 4 THICKNESS OF PIPE FOR VARIOUS BENDS

Up to 125 Lb. Working Pressure

Radius	Pipe Size—In.	Pipe Weight
4 to 5 diameters	7 and smaller	Extra heavy (Table 2.)
	8 and larger	½ in. thick
Over 5 diameters	7 and smaller	Standard wt. (Table 2.)
	8	28.809 lb. per ft.
	10	41.132 lb. per ft.
	12	50.706 lb. per ft.
	14 to 16 incl.	⅝ in. thick
	18 to 22 incl.	¾ in. thick
	24 to 30 incl.	⅞ in. thick

125 Lb. to 250 Lb. Working Pressure

Radius	Pipe Size—In	Pipe Weight
4 to 5 and 6 diameters	7 and smaller	Extra heavy (Table 2)
	8 and larger	½ in. thick
Over 6 diameters	7 and smaller	Standard wt. (Table 2)
	8	28.809 lb. per ft.
	10	41.132 lb. per ft.
	12	50.706 lb. per ft.
	14 to 16 incl.	⅝ in. thick
	18 to 22 incl.	¾ in. thick
	24 to 30 incl.	1 in. thick

250 Lb. to 300 Lb. Working Pressure

Radius	Pipe Size—In.	Pipe Weight
4 diameters and over	7 and smaller	Extra heavy (Table 2.)
	8 and larger	½ in. thick

TABLE 5. PIPE BEND DIMENSIONS[1]

Pipe Size In.	R Minimum Advisable Radius In.	Shortest Radius to Which Pipe Can Be Bent		T Minimum Straight Part		
		Standard In.	Extra Heavy In.	Screw or Shrunk In.	Welded Flange In.	Lap-weld or Vanstone In.
2½	12½	10	7	4		
3	15	12	8	4	5	6
3½	17½	14	10	5	5	6
4	20	16	12	5	5	6
4½	22½	18	14	6	5	6
5	25	20	15	6	5	7
6	30	26	20	7	6	7
7	35	30	24	8	6	8
8	40	34	28	9	6	8
9	45	42	35	11	6	9
10	50	45	40	12	7	10
12	60	54	50	14	7	10
14	70	70	65	16	7	14
15	75	75	70	16	7	14
16	80	80	78	18	8	16
18	108	90	88	18	8	18
20	120	104	104	18	8	18
22	132	132	132	18	9	20
24	144	144	144	18	9	20

[1] Dimensions for "Shortest Radius" Standard, are also for 14 in. *O D* pipe and larger, having ⅜ in or lighter metal.
Dimensions for "Shortest Radius" Extra Heavy, are also for 14 in *O D* pipe and larger, having ½ in. or heavier metal.

Spiral Riveted Pipe

This pipe is made up of wrought-iron or steel and comes black (natural color), asphalted or galvanized. Order by wire gage and weight as given in Table 8. It comes in 20 and 25 ft. lengths unless otherwise ordered.

If flanges are desired, state if they are to be "faced and drilled". The drilling will be A. S. M. E. Standard unless otherwise specified. Bolts and nuts do not come with flanges unless so specified

The working pressure to be used for any pipe must be stated, or used in calculating the weight of pipe to

TABLE 6. EXPANSION TAKEN CARE OF BY BENDS

Size of Pipe In.	Minimum Radius In.		Radius of Bends In.										
	Standard Pipe	Extra Strong Pipe	20	30	40	50	60	70	80	90	100	110	120
2½	10	7	⅜	⅞	1½	2¼	3¼	4½	5⅞	.....	.....	.....	.....
3	12	8	⅜	15/16	1⅜	1⅞	2¾	3⅜	4¾	6	.....	.....	.....
3½	14	10	5/16	⅝	1	1⅝	2⅜	3¼	4¼	5⅜	.....	.....	.....
4	16	12	¼	½	15/16	1⅞	2⅛	2⅞	3¾	4¾	5¾	.....	.....
4½	18	14	¼	5/16	⅞	1⅝	1⅞	2½	3⅜	4¼	5¼	.....	.....
5	20	15	.....	⅜	¾	1⅜	1¾	2⅜	3	3⅞	4¾	5¾	.....
6	26	20	.....	⅜	5/8	1	1½	2	2½	3¼	4	4¾	5¾
7	30	24	.....	.....	9/16	⅞	1⅝	1¾	2¼	2⅞	3½	4¼	5¼
8	34	28	.....	.....	½	¾	1⅛	1½	2	2½	3	3¾	4⅜
10	45	40	.....	.....	.....	5/8	⅞	1¼	1½	2	2½	3	3½
12	54	50	.....	.....	.....	½	¾	1	1⅜	1⅝	2	2½	3
14	70	65	.....	.....	.....	.....	.....	⅞	1⅛	1½	1¾	2⅛	2½

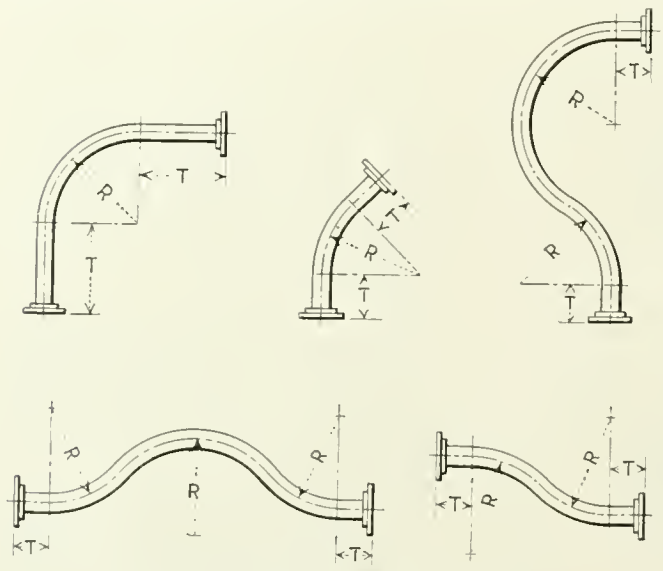

FIG. 1 BENDS FOR MAKING TURNS

order. It should be not more than 25 per cent of the bursting pressure of pipe ordered, which is calculated by Barlows formula as follows: $BP = \frac{2T \times TS}{OD}$ in which

BP = bursting pressure in lb. per sq. in.
T = thickness in in.
OD = outside diameter of pipe in in.
TS = tensile strength of material per sq. in.

Reference must be made to a table of equivalents of wire gage thicknesses in decimals of an inch to get thickness for T, and estimating OD. These tables will be found in engineers' handbooks and trade catalogues.

This class of pipe comes in 12 ft. lengths unless otherwise specified, so that to make up a total length which is not divisible by 12 one length will be special.

Cast-iron pipe sizes are always "inside diameters".

As to quality aside from the chemical analysis, the method of casting is the most important point.

In the "green sand method" the pipe is cast on its side with core nails and chaplets. Defective pipe is more frequently the result of this method of casting, and often the defects are not apparent until the pipe is put in use. In the "dry method" of casting any defect is at once noticeable on cleaning.

Specify cast-iron pipe by dry method.

There are several types of cast-iron pipe, but in the United States only two types are in general use—Bell and Spigot, and Flanged.

Both types are manufactured according to the standards of the American Waterworks Association and the various weights are given in the tables of weights of this Association, which are contained in the catalogues of all the manufacturers. Any other thickness or weight than those given in the tables of the A. W. A. will be special. As every use and pressure is covered, there is no need for any special weight of pipe.

Odd sizes are also special, for which an extra price will be charged. The odd sizes of cast-iron pipe are 5, 7, 9, 11, 15, 22, and 40 in. in diameter.

If the service to which the pipe is to be put is stated, and the pressure given, the manufacturer will figure on furnishing the minimum thickness the pipe will need, and his guaranty will make this selection good.

Flanged cast-iron pipe must be ordered "faced and drilled" or it will come in the rough casting. The drillings will be A. S. M. E. Standard for the pressures. Bolts, nuts, and gaskets are extra and must be specified.

The best way to make the joints on Bell and Spigot is by the "lead caulked" method. This requires that the specification include, "lead for joints".

If the one who is writing the specification for the

TABLE 7. EXPANSION OF PIPE
(In. per 100 Ft. of Pipe)

Temperature, Deg. Fahr.	Steel	Wrought Iron	Cast Iron	Brass and Copper
0	0	0	0	0
20	0.15	0.15	0.10	0.25
40	0.30	0.30	0.25	0.45
60	0.45	0.45	0.40	0.65
80	0.60	0.60	0.55	0.90
100	0.75	0.80	0.70	1.15
20	0.90	0.95	0.85	1.40
40	1.10	1.15	1.00	1.65
60	1.25	1.35	1.15	1.90
80	1.45	1.50	1.30	2.15
200	1.60	1.65	1.50	2.40
20	1.80	1.85	1.65	2.65
40	2.00	2.05	1.80	2.90
60	2.15	2.20	1.95	3.15
80	2.35	2.40	2.15	3.45
300	2.50	2.60	2.35	3.75
20	2.70	2.80	2.50	4.05
40	2.90	3.05	2.70	4.35
60	3.05	3.25	2.90	4.65
80	3.25	3.45	3.10	4.95
400	3.45	3.65	3.30	5.25
20	3.70	3.90	3.50	5.60
40	3.95	4.20	3.75	5.95
60	4.20	4.45	4.00	6.30
80	4.45	4.70	4.25	6.65
500	4.70	4.90	4.45	7.05
20	4.95	5.15	4.70	7.45
40	5.20	5.40	4.95	7.85
60	5.45	5.70	5.20	8.25
80	5.70	6.00	5.45	8.65
600	6.00	6.25	5.70	9.05
20	6.30	6.55	5.95	9.50
40	6.55	6.85	6.25	9.95
60	6.90	7.20	6.55	10.40
80	7.20	7.50	6.85	10.95
700	7.50	7.85	7.15	11.40
20	7.80	8.20	7.45	11.90
40	8.20	8.55	7.80	12.40
60	8.55	8.90	8.15	12.95
80	8.95	9.30	8.50	13.50
800	9.30	9.75	8.90	14.10

TABLE 8. SPIRAL RIVETED PIPE WEIGHT
(Per 100 Ft.)
No. 22, B. W. G.—No. 20, B. W. G.

Size	3 In.	3 In	4 In.	3 In.
Weight	115	147	195	242

No. 18, B. W. G.

Size	3 In.	4 In.	5 In.	6 In.	7 In.	8 In.
Weight	205	273	340	385	446	507

No. 16, B. W. G

Size	4 In.	5 In.	6 In.	7 In.	8 In.	9 In	10 In.	12 In.	14 In.
Weight	360	448	508	588	669	753	835	1003	1199

No. 14, B. W. G.

Size	6 In.	7 In.	8 In.	9 In.	10 In.	12 In.	14 In.	15 In.	16 In.	18 In	20 In.
Weight	653	755	860	967	1071	1287	1539	1649	1771	1974	2180

No. 12, B. W. G.

Size	6 In.	7 In.	8 In.	9 In.	10 In	12 In.	14 In.	15 In.	16 In.	18 In.	20 In.
Weight	858	992	1130	1271	1408	1692	2022	2167	2327	2593	2863

No. 10, B. W. G.

Size	12 In.	14 In.	15 In.	16 In.	18 In	20 In.	22 In	24 In.	26 In	28 In.	30 In.
Weight	2080	2486	2664	2861	3188	3521	3860	4216	4380	4720	5063

owner wishes to calculate the amount of lead needed, he will first look at his tables and note the depth of joint for the pipe in question and then refer to Table 9 for his information.

The actual weights may vary from 11 to 16 per cent from the ones given here, so it will be well to add that amount to any calculation. Allowance is made for the lead to project beyond the face of the bell for caulking.

It may be advisable to give a few illustrations of how to use the information contained in the preceding paragraphs when actually writing up a bill of material. Since most concerns have printed forms for such work "writing" a bill of material usually consists of filling in the blank spaces.

Suppose that 100 ft. of 3 in. wrought-iron pipe, lap-welded and shipped with the threads protected, is desired. By referring to Table 2 the weight per ft. length of this pipe is seen to 7.616 lb. and that figure is entered on the bill of material as the "quality" description. A special note is made of the desire for protectors on the threads.

A typical entry for a special length of pipe would be based upon information in Tables 1 and 2 as follows:

One piece 8 in. steel 25 lb. lap-weld pipe. Cut and threaded on both ends, length to be 10 ft. $6\frac{1}{2}$ in. end to end, thread to be 1 15 16 in. to be shipped with protectors on each end.

If several pieces of pipe are desired to make up according to a sketch to be sent with the bill of material something on the following order might be used:

Three pieces 10 in. steel 35 lb. lap-weld pipe. Each pipe cut and threaded on both ends to make up to center-to-center dimension given in sketch.

Assume that some spiral riveted galvanized steel pipe is required for an engine exhaust. By referring to a table of Brown and Sharpe wire gage equivalents and using Barlow's formula the bursting pressure for a given gage and diameter is estimated. Taking one quarter of the bursting pressure as a safe-working pressure it is found that No. 18 B. W. G. steel for an 8 in. diam. pipe will stand a working pressure of 129 lb. per sq. in. which is suitable for the service required. With this information the specification is written as follows:

Sixty ft., 8 in. galvanized steel, 507 lb. spiral riveted pipe, e. i. flanges, faced and drilled, bolts, nuts, and gaskets to be furnished.

TABLE 9. LEAD IN BELL AND SPIGOT PIPE JOINTS
(*Melville W. Durlee*)

Nominal Diameter In.	Approximate Pounds Lead in Pipe Joint 2 In. Deep	Approximate Pounds Lead in Pipe Joint $2\frac{1}{4}$ In. Deep	Approximate Pounds Lead in Pipe Joint $2\frac{1}{2}$ In. Deep	Approximate Pounds Lead in Solid Pipe Joint
3	6.00	6.50	7.00	10.25
4	7.50	8.00	8.75	13.00
6	10.25	11.25	12.25	18.00
8	13.25	14.50	15.75	23.00
10	16.00	17.50	19.00	31.00
12	19.00	20.50	22.50	36.50
14	22.00	24.00	26.00	38.50
16	30.00	33.00	35.75	64.75
18	33.80	36.90	40.00	72.00
20	37.00	40.50	44.00	80.00
24	44.00	48.00	52.50	95.00
30	54.25	59.50	64.75	117.50
36	64.75	71.00	77.25	140.25
42	75.25	78.75	85.50	155.25
48	85.50	94.00	102.25	202.25
54	97.60	107.10	116.60	238.60
60	108.30	118.80	129.50	255.50
72	128.00	140.50	153.00	302.50
84	147.00	161.50	175.60	348.00

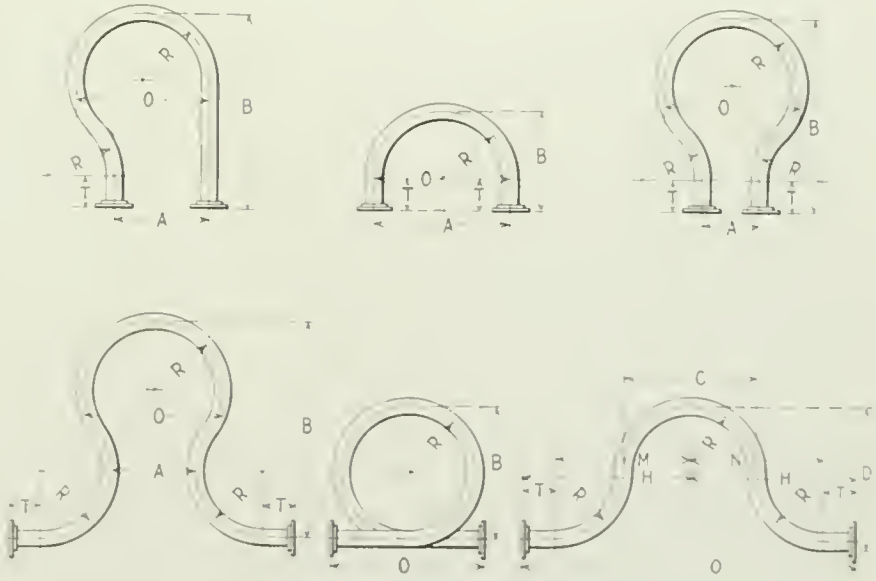

FIG. 2 BENDS FOR TAKING UP EXPANSION

THE EDITORS' PAGE

Management and Material Handling

THE materials for manufacture are in process from 20 to 25 per cent of the time and being handled or in storage the other 75 to 80 per cent. On a time basis the management of the operations of handling and storage overshadows the management of processing. From the viewpoint of possible progress in manufacturing the management of handling materials outranks the other two.

Recognition of this situation is the reason for the six material handling articles which form a group on pages 533 to 564 of this issue. Each paper deals with an important phase of the general subject, is written by some one who can speak with authority, and taken together they show practice drawn from upwards of 50 representative firms.

Two major advantages are emphasized and re-emphasized in these articles:

1. Material handling equipment helps the management manage.
2. Material handling equipment helps make profits.

One of the axioms of management was stated by Gantt in these words:

> Two-thirds of all the gain possible through the most efficient management can be realized by having all the material ready *when you want it, where you want it,* and *in the condition you want it.*

Now material handling equipment delivers material "when you want it" and "where you want it". Properly installed, it makes possible two-thirds of the gains which Gantt attributed to the most efficient management. Herein lies one of the far-reaching reasons for the application of material handling equipment.

It is easy to support this fact by illustrations. The assembling line developed to such a high degree in automobile building is a material handling means for bringing together the parts of an automobile *when* and *where* they are wanted. The effect of this assembling chain upon production is too well known to need emphasis.

A gain of the same order has been made in a large cotton mill in New England, the details of which we presented in our April issue.[1] The great lesson which that installation teaches is presented in the present number by Robert T. Kent, beginning on page 539.

Two statements can be made of this lesson depending upon the approach:

1. To secure profitable results from a material handling installation good management must prevail.
2. The effect of an adequate material handling installation is to compel the management to do its own job.

[1] See MANAGEMENT AND ADMINISTRATION, April 1924, p. 411.

Much discussion has taken place in the past as to just what means can be adopted to make the improvements and betterments put in by modern management permanent. Within certain limitations one answer has been found. Establish mechanical control of your material as to when and where it is to be delivered and you have established one means of holding your management in line and securing permanency for your managemental methods.

Profits from Material Handling Equipment

THE decision for or against an installation of material handling equipment is based fundamentally on a dollars and cents comparison. Choice of types undergoes the same test. In each case the object is to bring about savings and add to profits.

In many industries of a highly competitive nature the question goes even deeper than profits. Where equipment has reached such an advanced stage of development as to have become a vital part of manufacturing processes, the very existence of each individual concern depends upon the application of such apparatus. Without it the firm cannot stay in business.

The relation of equipment to profits is often tied up with other considerations. On undesirable handling jobs labor shortage, or a high rate of turnover, is frequently assigned as the reason why mechanical methods must be substituted. However, if the rate of pay is attractive, no shortage or turnover would be experienced. It is because a manufacturer cannot afford to pay high wages for this type of work, while his competitor is saving money by the use of effective and speedier methods, that he must turn to equipment himself. The costs must be cut and mechanical devices offer the solution.

Certain types of apparatus, such as electric cranes and hoists, locomotive cranes, and the like, are used for the reason that the work they do could not be accomplished by hand. As a matter of fact, however, practically every lifting or moving job *could* be performed by man-power with crowbars, rollers, jacks, derricks, and other hand devices, but the cost would be absolutely prohibitive. Because of our familiarity with the fact that these classes of equipment are indispensable, we habitually forget to credit them with the vast increases of production and the tremendous industrial economies which they have made possible.

Manufacturers are beginning to measure carefully the savings that can be brought about by the use of material handling equipment. Records of performances before and after apparatus is put in commission are now being made in many cases. Some data collected are general and express only the approximate overall economies resulting. There is a growing tendency, however, to make more exact analyses. This movement is typified by the 55 specific plants mentioned in

an article in this issue on "Materials Handling Methods That Have Added to Profits". The figures in this compilation are presented as supplied by the plants themselves. They are all taken from actual experience, and are recorded in the files of the concerns where the apparatus is in use.

A handsome return on the investment is shown in every case. The 100 per cent mark, and total savings up to $40,000 per year, become almost common, and these for widely varying types of material handling apparatus. The indirect savings, however, have not been fully included in any instance. Installations of equipment are charged with all proper items of burden, but have not been credited with the elimination of the heavy overhead costs incident to hand labor methods. When this added amount, varying probably from 50 to 150 per cent of the direct labor charges under hand-operation, is figured in, the economies need no further demonstration.

Using only the actual dollars and cents savings given in 30 of the 55 cases listed, a total annual economy of $597,700 is summed up. Another $265,000 is added when nominal wage rates and values are applied to 18 more cases where only comparative numbers of men are stated. Crediting the elimination of burden attached to hand labor adds another $360,000. The sum total of all economies, except increased production, is in excess of $1,222,700 each year, and only 55 of the thousands of industrial plants are included, which do or can use mechanical handling equipment.

With this array of experience data in hand, but one conclusion can be drawn. It will pay every man charged with the duties of plant operation, or with the financial responsibilities attached to the office of superintendent, manager, comptroller, president, or director—wherever the selection of apparatus and approval of expenditures for it are lodged—carefully to investigate each hand method now employed in his plant in handling materials, to see what savings can be brought about by the substitution of mechanical equipment.

Go South, Young Man!

MORE than half a century ago Horace Greeley so persistently used the columns of *The Tribune* to advocate the claims of the great and then undeveloped West as the land of opportunity for young men, that it became a national aphorism and undoubtedly influenced untold thousands. Now the West has developed marvelously and in large part because of the armies of enterprising young men who went there and grew up with the country, meanwhile helping to work out its wonderful economic development. There are still opportunities in the West but they are not in conspicuous abundance and the best of them are taken up and utilized by the young men already there—by the graduates of its own colleges and technical schools.

There is still, however, the great and potentially wealthy South which is yet far—very far—from the attainment of the economic importance it should have. There the gates of golden opportunity are still open for those who bring the qualities and qualifications that will enable them to enter. And in the southern country there is a section, almost at hand, in which "there has taken place in a comparatively few years a rapid but steady industrial and commercial growth, with an accompanying increase of wealth, which has not been equaled for a like area in recent years by any section of the United States."

In another part of MANAGEMENT AND ADMINISTRATION appears the first of a series of articles by Ralph G. Macy treating of the conditions and great promise of this nearby, but little known, part of the South—the Piedmont Section of the Carolinas—a strip of land stretching across North and South Carolina some 250 miles long and some 75 miles wide—the land of opportunity. Already its cheap and ever-availing hydro-electric power is being tapped on a vast scale and great manufacturing industries are being developed. Already streams of capital seeking investment are flowing into new productive enterprises. Already ambitions and far-seeing men are planning new possibilities of lucrative industry. In the northern part are—

> . . . . great tobacco plants, knitting mills, and colored goods mills. Here also is the furniture industry which obtains lumber from the wooded slopes of the Blue Ridge Mountains. In the central part are concentrated the cotton yarn mills and in the southern portion are the gray goods and sheeting mills and the bleaching and finishing plants.

What is of special interest to young men and most of all to those whose technical education and experience have fitted them for service in modern industrial development is Mr. Macy's account of the opportunities there for such men.

> There is undoubtedly a shortage of technical men and executives. Many of these cotton mills were started by merchants and bankers, and 20 years ago the need was not felt for men with technical training. However, in late years the realization of the value of this type of man to the industry has gained ground rapidly, and also the realization of the value of a certain amount of research work in connection with this industry. The older managers and superintendents are retiring and with the erection of new mills there are exceptional opportunities for technically trained men and executives.

It must not be inferred, however, that the Piedmont area is an occupational Eldorado where competing plants bid against each other to secure the service of newly graduated technical men and untried executives. It is, though, a rapidly growing part of the country where trained ability will find abundant opening. For the most part a beginning must be made close to the bottom and the way up involves some unusual elements of drudgery and denial. The 10-hour day, which still prevails in the Piedmont mills involving unexpected adjustments of social life and outside activities, is a real shock to many who come to this section. Other local conditions must also be recognized and accepted. There are, however, many responsible positions to be filled by those who will meet the conditions, and the men who can qualify will probably achieve quicker, and perhaps greater success here than in any other part of the country.

THE READERS' PAGE

Producing More Industrial Executives

THE discussion of the difficulty experienced by young men in obtaining industrial jobs that has appeared in recent issues of your publication has inspired me to add my own experiences in the form of a query to which I should greatly appreciate an answer.

I am an engineering graduate of a well-known university, have intensively studied business management theory for 5 years, and have held jobs ranging from junior executive down for about the same length of time. I have at least average intelligence, and since management problems are intensely interesting to me I have acquired a fairly good practical knowledge of business as a result of my 5 years of effort.

A little more than a year ago I arrived at a position from which I could see small prospects for the future. My own views were confirmed by my chief who confessed that, because of the peculiar internal organization of the company, I had climbed as high as I would be likely to go for several years to come. Realizing that such a position was not particularly agreeable to me he advised me to seek another where the upward way would be more open.

I took his advice and started looking for another job. Up to a few weeks ago I was still looking—more than a year after I started.

Continually one reads of the shortage of executive material—where are the managers of tomorrow? Why are not more of the right type of young men turning to business? My query, based upon a year's disappointing experience, is to know if this complaint is real or rhetorical, and, if real, why do business men fight so hard against a remedy?

My demands for the job I was seeking were not excessive. The principle one was that I be permitted to move up as my value increased—not an uncommon demand, certainly. Salary was not especially important to me. I expected to get enough to support my family decently at the start but was quite willing to let my work govern my future wages.

To offer my prospective employer I had education, youth, ambition, considerable experience, and a satisfactory record of results achieved which could be verified by any or all of my former employers.

With those points as my program I blithely started my search, confident that with so many young men needed I would quickly secure a satisfactory connection.

I wrote letters to hundreds of firms; I replied to "help wanted" items in trade papers; I enlisted the services of three different employment agencies; I inserted advertisements in trade journals; all with no result.

After I had spent several hundred dollars and countless hours of spare time I concluded that I had a very difficult selling proposition on my hands. Instead of all business heads being constantly in search of men they seemed to be taking every precaution lest they come in contact with a promising one and have to hire him. To be successful in my quest I saw that I must use expert selling methods. I obtained expert advice concerning my letters and my ads with no better results than before. When I had about decided that there was not an opening in the country for a man with my qualifications I found one that answered all my requirements.

My own troubles are over, but there must be hundreds, even thousands, in the same position in which I found myself. They are the sort of men you executives want but under the present system of employment you make contact with them almost impossible. They are excellent material for future executives yet you insist that they be expert salesmen before you will even see them.

Grant that your time is valuable and you cannot possibly see every man who wants to work for you. Grant that for every *good* man that applies there may be dozens that are worthless. Still if you can find some way to assist the worthy to a suitable position the time so spent will not be wasted.

There are loads of square pegs that have settled permanently in round holes because their attempts to find square holes have met with so little encouragement. It is to your advantage that they all find their proper position in industry but how can they do it without your help?

If there is a shortage of executive material why is there such resistance against measures that may alleviate the condition?

Yours very truly,

HENRY WARREN

Will some executive with experience on the other side answer Mr. Warren's inquiry? The whole matter is one of bringing the buyer and seller together but when both are so greatly advantaged by being brought together the "contact" should be made with less difficulty.

A Gantt Chart to Control Inventories and Purchasing

THE use of the Gantt Chart is rapidly being broadened. An important application which has not been discussed as yet or has not come to the attention of the writer, is that for depicting continuously the status of inventories of goods to be used in process. To maintain sufficient quantities of a number of articles on hand to be used in manufacturing processes, and at the same time to avoid tying up large amounts of capital in goods likely to depreciate in value, is a problem present to some extent in practically every industry. While the presentation of a momentary condition of inventories is discussed in Clarke's book and

other articles on the Gantt Chart, the broader application mentioned above is not apparently considered.

A case which the writer has in mind is that of a medium-sized furniture factory, turning out in particular a selected line of chairs, rockers, and overstuffed davenports, upholstered in costly tapestries, mohairs, etc. The customary factors affecting the supply of any goods to be used in process are present in the case of these upholstery goods, viz.: time required to fill orders (by the manufacturer of the materials); time required to receive shipments; and amounts of each kind of goods required (actual average for a period just past, estimated average for a period in the future).

Variations of the last-named factor, in the furniture business at least, are so great as to render most difficult the placing of orders in any systematic manner whatsoever. To the writer's mind, however, this but emphasizes the need of proper control, such as might be furnished, for example, by the Gantt Chart. Could not the principle of this excellent method—namely the fixing of the relationship of quantity and time, and the plotting of quantities by horizontal lines—be used in cases of this type? The amount of each kind of material on hand, the approximate length of time this will last, and the time when new orders must be placed to insure continuous production by having a proper supply of goods on hand, might all be shown simply and compactly. The writer is experimenting with this application of the Gantt Chart, but no doubt others have already made good progress in this field and suggestions from them would be appreciated.

Sincerely,

LAWRENCE W. CONANT

Management and Mechanism

THE instructive article of Robert T. Kent on page 411 of the April issue can be taken as one answer to the old question—How far is management concerned with mechanism and mechanical devices? The query may seem harmless but two camps have taken opposing points of view in regard to it. Possibly these opponents were never more sharply put in contrast than at the meeting held in New York City during Management Week of 1922. The paper for discussion was presented by L. P. Alford, in which he showed the development of the practice of management by discussing eight management mechanisms, their economies, and relative adoption. As I gathered, he was advocating the proper use of management mechanisms as a great step in making the advantages of good management permanent in industrial operation.

Several of his opponents declared that mechanisms were trifles, that the all-important were general principles and particularly the "psychological touch". They seemed to say that it mattered little what kind of a management mechanism or tool you used provided your mind and heart were right.

Now, I should be the last person to object to a right attitude toward life and work. No one can really accomplish much unless he has a "willingness to do". However, as a hard, stubborn fact I know that the "willingness to do" can accomplish more with efficient tools than with poor tools or no tools at all. Therefore, I believe in management mechanisms as well as in general principles and inspiration.

Coming back to Mr. Kent's article it seems to me that he has shown a close connection between management and materials-handling equipment although he does not say much about the former. Broadly stated, the production and quality of goods were improved by the installation of equipment, and in summing up, Mr. Kent says, "The development of the conveyor system probably represents one of the greatest steps in the textile industry that has been made in many years". Now this step forward was made by the management of the Jackson Mills and I cannot but believe that management methods as well as material handling methods have been combined to produce the satisfactory result.

One of these days no well-managed plant will lack a fully developed, adequately operating stores system, a cost system, routing and dispatching of work, selection and placement of workers, purchase system, incentive wage plan and possibly others. In a textile mill you will look for them as much as for spinning frames and looms; in a machine shop they will be as much in evidence as machine tools; in a pottery they will be as much a matter of course as the firing kilns.

Perhaps some of the readers of MANAGEMENT AND ADMINISTRATION who are boosters for principles and inspiration will object. If so, let them come on.

A. L. PRATT

Upon What Should the Public Accountant Base His Fees?

A RECENT editorial in *The Journal of Accountancy* contains a discussion of the subject of contingent fees, the writer thereof expressing his firm conviction of the undesirability of that basis of compensation for professional services.

Among the statements contained in the editorial were the following:

> At first glance it appears quite fair that a professional man undertaking certain work for his client should receive compensation commensurate with the success or failure of his effort.
>
> It is quite plausibly argued that where results are unsatisfactory to the client, he should not be expected to pay for services as he would pay in the case of greater achievement.

Having in mind the fact that the conclusion reached in the editorial is contrary to that expressed in the paragraphs quoted, attention is invited to some of the reasons for advocating contingent fees in certain cases.

Compensation Based Upon Results

It would be difficult to imagine a basis of compensation more equitable and satisfactory than one based upon results. All the commissions and bonuses of the business world are predicated upon the assumption that

those who produce most should receive the most compensation.

As an incentive to the utmost endeavor this basis of compensation occupies a unique position, it being universally conceded that it is the best system yet devised to produce the desired results.

The reason for fees is the fact that certain services either have been or are to be rendered and the amounts of the fees, irrespective of their bases, should be such that both the profession of accountancy and the business of the community will be benefited thereby.

Cases Involving Contingent Fees Not Numerous

Accountancy engagements in which contingent fees are likely to be agreed upon are not numerous and the majority of them probably represent tax cases in which there is reasonable ground for doubt as to the results obtainable from the proposed work. In a case of this kind a taxpayer would rather suffer a loss of taxes paid than expend additional sums in an attempt to recover amounts which he thinks may have been overpaid. If an accountant examines the tax returns of such a taxpayer and after offering his services upon a per diem, or fixed fee, basis is unable to convince him that it would be money well spent to prepare a claim for refund, it is manifest that the accountant would be remiss if he did not accept the offer of the taxpayer and proceed with the work on a contingent fee basis.

No argument can be advanced which will negative what may be called the self-evident conclusion reached in every such case.

Some of the reasons advanced against contingent fees seem to imply a lack of confidence in the integrity of accountants, as does also the announced determination of the Treasury Department to discourage contingent fees in the handling of tax and other cases before it.

The record of professional accountancy is one which compares very favorably with that of the other professions, and if appropriate publicity is given to violations of laws (as distinguished from resolutions) the results will be corrective and they will bring about an early determination of the questions involved.

Government by Resolution

The chief criticism to be directed against the resolutions sometimes adopted which forbid contingent fees is their impotency; they so frequently lack a power of enforcement and are, to that extent, a misdirection of effort, and remind one of the words—"And waste its sweetness on the desert air".

To state that contingent fees may be proper in some cases and then to indicate an attempt to discourage that basis of charge accomplishes nothing except to leave the accountant uncertain as to how he should proceed in the event that a case is offered to him on such a basis.

No surer way to inculcate a contempt for law is known than failure or inability to enforce the laws which are enacted, and the same thing holds true in its application to resolutions. The unnecessary multiplication of either can only have a detrimental effect upon the attempted enforcement of just laws and the effect upon human conduct of reasonable resolutions.

Assuming that with a full knowledge of all the material facts an accountant enters into an agreement with a client to perform specified services, payment therefor to be based upon results, and that he performs those services as originally contemplated, and is paid the fee provided for in the agreement, can it be truly said that there is anything in such a transaction to offend the conscience or which is in any way detrimental to the interests of the accountant profession or to the business community?

Were it not for the doubt created by resolutions and rulings, the parties to such an agreement would have every reason to believe that they had acted in a manner befitting their respective callings and without prejudice to their standing therein.

The settlement of debated questions by the adoption of resolutions seems like burying the hatchet with the handle out.

They remind one of incidents such as the following:

> In October 1635, Roger Williams, because of his inspiring pleas for individual liberty, was ordered by the General Court of Massachusetts to leave the Colony forever. He went to Rhode Island, where he lived for nearly fifty years. But the official conscience grew a little restless, and in April 1899, Massachusetts actually made atonement for its rash act. The original papers, yellow faded and crumbling, were taken from their pigeon hole tomb, and by an ordinary motion made, seconded, and adopted, the order of banishment was solemnly annulled and repealed and made of no effect whatever. The law under which Roger Williams had lain over 260 years, was lifted. And there is no reason now, according to law, why Roger Williams cannot enter the State of Massachusetts and reside therein. The action was to the credit and honor of the State; it was right in its spirit, and Roger being in the spirit for more than two centuries, may have smiled gently and understood.

respecting which comment is unnecessary.

Basis of Accountants' Compensation

The analogies which are drawn between the professions of law and medicine on the one hand and accountancy on the other, are wholly irrelevant, inasmuch as the present general basis of remuneration of accountants is more comparable to that in the trades, in which compensation is based upon the time consumed in performing the work.

Lawyers and doctors do not usually base their charges to clients upon the time element of their professional efforts, but upon the importance of the work performed, together with a consideration of the ability of their clients to pay therefor.

The amount of the fee charged by a lawyer frequently depends upon the ability of the client to pay, and is analogous to a contingent fee by an accountant, the ability of the client to pay, in both cases, often depending upon the amount saved or recovered.

Among public accountants, as among other professional men, a good reputation is of great value, both to the accountants and to their clients, and the more widely a knowledge of the accountants' reputation is disseminated the greater is the value of the services which they can render.

Other things being equal, a firm of accountants of long standing and enviable reputation is entitled to charge more for the services it renders than one more recently established and with only a limited field of experience in which to demonstrate its professional ability.

To discuss the basis of compensation upon the theory that every accountant is an accountant, and all, therefore, should be entitled to the same rates of compensation, is so fallacious an argument as to need no contradiction and yet the basis of compensation usually advocated proceeds upon this erroneous assumption.

The "Knowing How" Factor

The "knowing how" factor is one that is sometimes overlooked. A story is told of a householder who employed first one, and then another, mechanic to repair his heating plant. They both sent him bills "for services rendered $15," but failed to locate the seat of the trouble, and it was necessary to call in a third who quickly saw where the difficulty lay and, with slight expenditure of time, made the necessary repairs. Having learned of the unsuccessful efforts of those who preceded him, and possessing a saving sense of humor, he rendered a bill "time consumed in doing the work $5; knowing how $10, total $15," for which he received prompt payment.

The "knowing how" capacity justifies a somewhat different method of treatment than is accorded the ordinary handling of a piece of work, professional or otherwise; a fact which should be considered in any discussion of the basis of compensation for professional services.

What would be an exorbitant fee in one case might be looked upon as a very small fee in a similar case, the difference being the interests represented in the two cases, the question of their respective ability to pay governing the fees in both cases.

The Value of Services

The answer to the question—"What is the value of the services?"—in a particular case would seem to depend upon the facts involved therein, and for anyone not a party thereto to lay down a rule by which the parties shall be governed seems to be an unwarrantable interference in the affairs of others who, it may be, are equal to the task of taking as good care of themselves as are their self-appointed guardians.

It may sometimes happen that they are entirely capable of looking after their own interests and will accordingly resent what seems to them an unnecessary interference with their contractual rights.

The ideal arrangement between an accountant and his client would be to have the client pay a retainer, to cover consulting services only, and to make a separate charge for all other services rendered at agreed-upon rates.

At the present time accountants do not bring the advantage of consulting services strongly enough to the attention of their clients, with the result that matters relating to the accounts of many firms do not currently receive the attention which they would if consulting services were being availed of.

The question of what should be the basis of an accountant's fee is a broad one and, as in other professions, it has not as yet been definitely settled in a satisfactory manner.

Education of accountants along ethical lines will be a step in the right direction. But the mere passing of resolutions will do very little to overcome a so-called unethical practice which is not so considered by a large percentage of the practitioners of accountancy or their clients, and which cannot be considered wrong except from the standpoint of prohibition by resolutions and rulings.

The total volume of accountancy services performed could well be multiplied many times, with corresponding benefits to accountants and their clients.

Assuming the integrity of professional accountants, it makes but little difference what basis of compensation is adopted—the laborers will still be worthy of their hire.

Sincerely yours,

ROBERT ATKINS

"Signed or Unsigned"

I AM interested in the subject of professional advertising, perhaps because for a number of years I was engaged in the publishing business, and I do not believe that the last word has yet been said on the subject.

I am contributing some further ideas herewith chiefly for the purpose of keeping the topic alive. I am encouraged to do so by observing that one of your April communications was unsigned. The rules of publishers differ as to this. I would prefer that my communication, if accepted, should appear either unsigned, or with a *nom-de-plume*, partly because I would not have it inferred that the firm with which I am connected supports my views, to which as yet they are not entirely converted, and further because I think it better for the arguments to be considered on their merits and apart from any relation with the personal position of the contributor.

Yours very truly,

JOHN MIDWEST

The communication on the subject of professional advertising referred to in Mr. Midwest's letter—which is given under his *nom-de-plume*—will appear in the June number of MANAGEMENT AND ADMINISTRATION. It is an open question as to whether letters appearing in these columns should be signed or unsigned. Where the standing and experience of the writer give weight to what he says—a weight that could not be given by the mere phraseology of the letter, it is manifestly better for it to be signed. Where, however, the letter merely asks for information or comments in fields where trained observation and experience do not count so heavily, the matter of signature is one of comparative indifference. The editors are always very willing to comply with the wishes of contributors as to signature.

NEWS OF EQUIPMENT
FOR THE MANAGEMENT

This department is conducted to give the essential facts in regard to items of industrial equipment which have recently been placed on the market, and which may be used in the operation of manufacturing concerns. As the sources of the items are reputable manufacturers, MANAGEMENT AND ADMINISTRATION accepts this information as reliable.

—THE EDITORS.

New Pneumatic Drill

Index Number
621.95 Drills

A NEW size, light-weight, non-reversible, pneumatic drill has been brought out by the Ingersoll-Rand Company. This new drill is known as Size D and is suitable for light

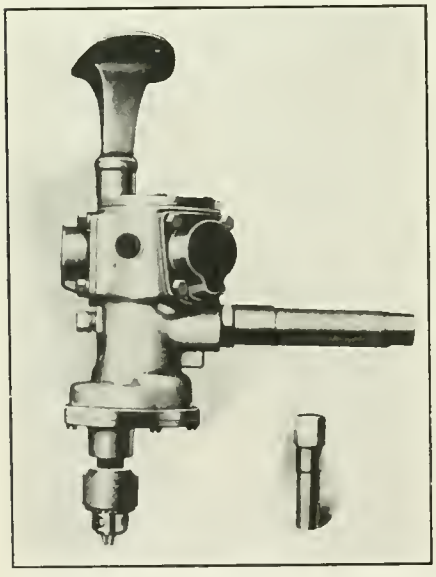

FIG. 1 LIGHTWEIGHT PNEUMATIC DRILL

drilling up to 9-16 in. diameter holes, and reaming up to 5-16 in. diameter.

This is a light-weight drill which may be fitted with either breast plate, feed screw, or grip handle and so made adaptable for a wide variety of work.

The features of this type of machine are briefly: light-weight aluminum case, with steel bushings cast in all the bearing holes and the throttle hole; cast iron cylinders which are renewable and interchangeable; and special three-cylinder motor. The renewable cylinders are a valuable feature, as any cylinder after long service may easily be replaced and the motor made as good as new at slight cost.

The three-cylinder motor has the rotating parts all accurately balanced, eliminating vibration and reducing wear and tear on the machine. The drill is very economical in air consumption and cost of maintenance, is high-powered, and, moreover, every part is readily accessible for inspection.

The details of the Size D Drill are as follows:

Recommended working speed at 90 lb. air pressure	700 r.p.m.
Weight (incl. breast plate and chuck)	14 lb.
Length of feed (with feed screw)	2½ in.
Standard twist drill will drive	9-16 in.
Size reamer will drive	5-16 in.
Length overall (with breast plate and chuck	15 in.
Distance from side to center of spindle	1½ in.
Size hose recommended	½ in.

A Movable Lift-Truck Platform

Index Number
658.281 Movable platforms

THE H. Zering Manufacturing Company has made an addition to the list of material handling equipments in providing a lift-truck platform which can be moved without the aid of a truck. As illustrated it is equipped with casters by means of which short moves are easily made and long ones are possible.

By using this type of platform it is to be expected that fewer trucks would be necessary inasmuch as comparatively short movements would be made without their use. Also a considerable portion of the worker's time which is wasted in locating a lift truck or tractor, or in waiting for one to arrive, can be saved.

FIG. 1 MOVABLE LIFT-TRUCK PLATFORM

The platforms are made in the standard sizes either of wood or steel and can be supplied with stake sockets, made in box form or other variations.

A New Recording Controller

Index Number
662.612 Recording thermometer

THE C. J. Tagliabue Mfg. Co., has added to its instrument line a combined Recorder-Controller. In this design an air-operated temperature controller mechanism and a recording thermometer are mounted in the same case and are actuated by the same thermostatic system. All the structural features of the TAG Recorder such as the uniformly graduated chart, non-corrodible inverted fountain pen, pen pressure and position adjustment, improved chart-holder, are incorporated in this design. An important improvement is the entire elimination of the rubber connections usually employed in instruments of the combined form.

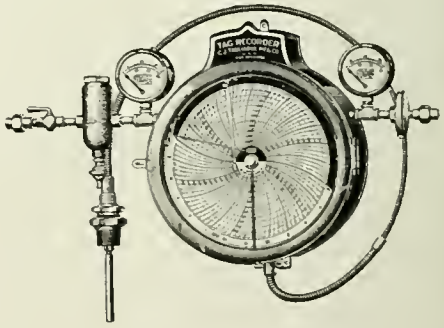

FIG. 1 COMBINED RECORDER-CONTROLLER

This device is intended for use wherever precise control of temperature is desired. Similar devices can be furnished for precise control of pressure or humidity.

Loose Pulley Bushing and Oiling Device

Index Number 621.89 Lubricating device

A NEW principle of oiling loose pulleys and idlers is represented by the "Gast," recently placed on the market by Standard Pressed Steel Company. In this device the bushing proper and the oil chamber are separate—so interlocked that they cannot be taken apart, but free to revolve in relation to each other. Because of this arrangement the oil chamber remains stationary on the shaft while the bushing revolves,

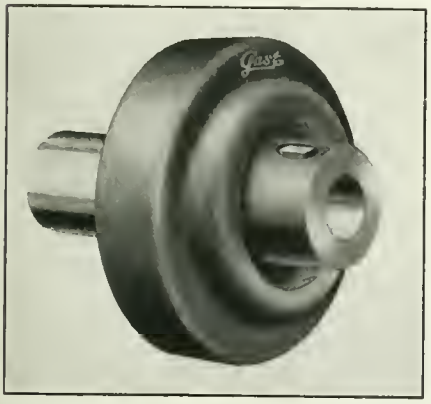

FIG. 1 "GAST" LOOSE PULLEY BUSHING AND OILING DEVICE

thus eliminating the effect of centrifugal force on the oil and insuring adequate lubrication. The device is so built that oil is deposited on the shaft once during every revolution so that the amount of lubrication is always directly proportional to the need. Means are provided for returning the oil to the oil chamber so, since the "Gast" does not leak, one filling will last for a very long period, although the manufacturers advise renewing the oil about every three months.

A Mechanical Weighman

Index Number 681.16 Weighing scales

STILL another adaptation of weighing in motion has been recently devised. The apparatus may be applied to very nearly any type of scale.

It consists of a beam and sliding poise similar to that of an ordinary platform scale, with the exception that the poise travels mechanically

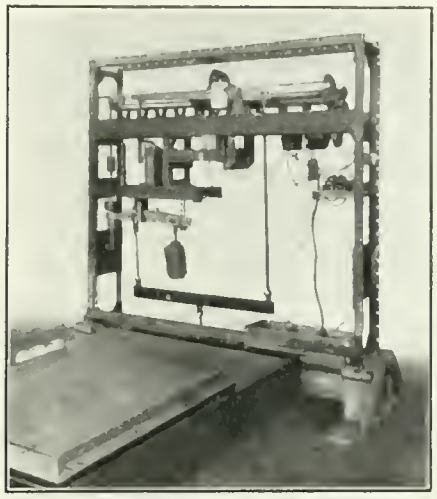

FIG. 1 MECHANICAL WEIGHING DEVICE

instead of being moved by hand when the load is applied.

This attachment has been utilized on platform scales, replacing the hand-operated beam; monorail systems for obtaining the weight of material as it travels over the monorail track in tubs or buckets; grab bucket installations mechanically weighing the bucket of material as it is hoisted from the stock pile. It is also applied to the industrial track scales weighing cars of coke, coal, or other materials and doing it without the aid of a weighman.

A printed record of the individual weights as well as the total weights may be obtained on a ticket or continuous tape. With this device, the weighman is entirely eliminated, a mechanical weighman taking his place. The scale is mechanical in all its motions and only operates when the load is placed on it and comes to rest after the weighing and recording of the load has been accomplished.

This device is being manufactured by the Merrick Scale Mfg. Co.

Industrial Heating Equipment

Index Number 625.25 Industrial heating

AN important feature in this new piece of factory heating equipment which has been developed recently by the American Blower Company is the fact that the steam coils are made from copper and brass, which offer far less resistance to the transmission of heat than iron does. In addition to this each tube is wound, helically, with a copper ribbon in such a way as to form a continuous fin. This fin is bent to form a large surface of contact with the tube and the union is treated so that the two parts become metallically integral. By this method of construction the heat transmitting surface is made nearly five times greater than that of the tube alone. Each unit is complete in itself, and because of its light weight can be used where other installations would be impracticable or too cumbersome. No heavy framework is required, so that it may be installed in out-of-the-way places with little trouble. Where floor space is at a premium they can be hung from the ceiling although this type of installation is less satisfactory than the standard method. The units can be made to discharge in any direction, or two or more units can be combined in a single housing. The over-all dimensions of a single unit are 2 ft. 5 in. high, 2 ft. 8 in. wide, 2 ft. deep through the motor

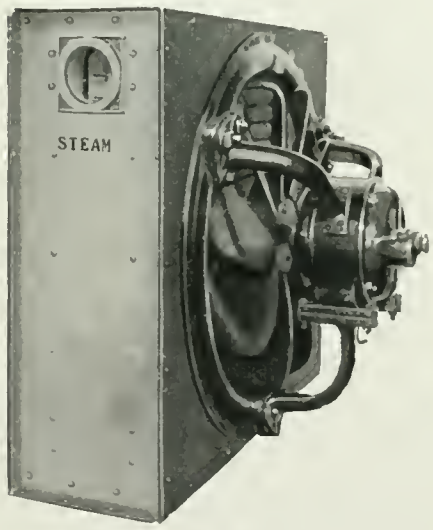

FIG. 1 INDIVIDUAL HEATING UNIT FOR INDUSTRIAL PLANTS

shaft, and 10 in. deep for the heater alone. The weight of a unit is in the neighborhood of 300 lb. It is built to withstand a steam pressure of 50 lb. and any vacuum. Its capacity is approximately 3000 cu. ft. of air per min. heated from 60 deg. fahr. to 115 deg. fahr. with steam at 5 lb. pressure, corresponding to 150,000 B. T. U. per hr.

A Ventura fan is an integral part of the construction.

An Improved Valve

Index Number 621.84 Valves

A VALVE called the "Borsig" has been used in Europe for a considerable period but is just now being introduced in this country by the Techno Service Corporation. This valve has 3 main advantages which are: toggle lever action, creating a force sufficient to close or open the valve against a pressure of

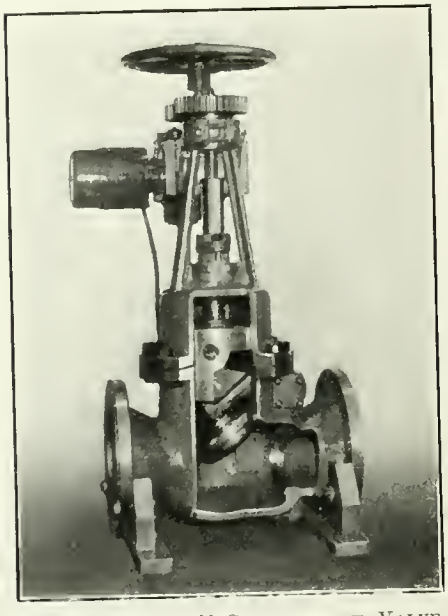

FIG. 1 "BORSIG" STRAIGHTWAY VALVE FOR STEAM SERVICE

300 lb. regardless from which side the steam enters; when opening valve the disc disappears in the bonnet, thereby leaving a straight unobstructed passageway for the steam; should regrinding become necessary, the valve seat can be reground by simply removing the bonnet and gradually revolving the disc against the valve seat by means of an especially fitted key furnished with each valve. It is suitable for steam pressures up to 300 lb. per sq. in. superheated to 400 deg. cent. Because when opened the whole cross-section of the valve is available for the direct passage of steam without change of direction, there is no appreciable loss of pressure even with steam at very high velocities. At a velocity of 230 ft. per sec. the drop in pressure is only 1.1 lb. per sq. in. The casing is of cast steel, the valve-seat rings are of nickel steel, and because of its sturdy construction repair work on the valve is reduced to a minimum.

New Graphic Chart Sheets

Index Number 651.64 Graphic sheets

IN response to suggestions received as a result of a questionnaire sent to their regular customers, Codex Book Company, Inc., has published three new graphic chart sheets. The first two are on standard 8½ x 11 in. paper and are ruled 10 and 20 divisions per in., both ways, all lines of uniform heaviness. The omission of all heavy lines makes them adaptable to a great many uses. The third sheet is 11 x 16½ in. It is ruled with 12 divisions per in. the long way and with one 9 in. cycle of ratio ruling the other way. The plain ruling lines are all of uniform heaviness to permit division into any desired periods.

An Improved Centrifugal Pump

Index Number 621.67 Pumps

A NEW centrifugal pump, featuring an improved rubber sealing ring on the impeller between the suction and discharge chambers and the use of a metal graphite packing ring has been placed on the market by the Moore Steam Turbine Corporation.

The metal graphite packing rings rest lightly on the shaft and do not produce binding effect, and attendant retardation of rotation. The new packing ring is not affected by hot or cold water and, once it is properly fitted, leakage is reduced to a minimum. It is long-lived when the shaft runs without eccentricity. With this pump the manufacturers expect to obtain from 5 to 10 per cent more efficiency than from other types of the same size.

They can be furnished in the following sizes: 3, 4, 5, 6, 8, 10 and 12 in. single stage, double suction pumps; and in 3, 4, 5 and 6 in. multistage pumps. They are all fitted for belt, motor, or turbine drive and although designed primarily for pumping water, they may be adapted for pumping oil or other liquids. The pumps are horizontally split and use brass protected, chrome nickel steel shafts.

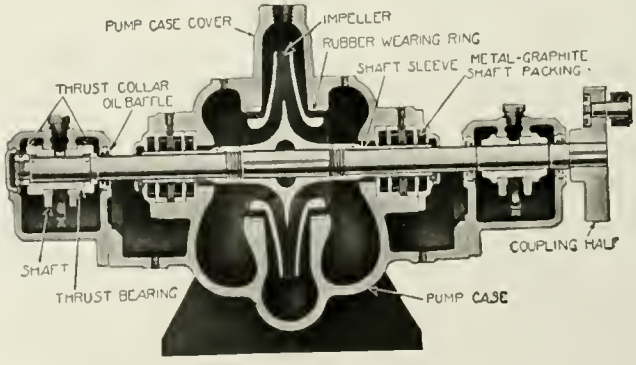

FIG. 1 IMPROVED CENTRIFUGAL PUMP

New Electric Hammer

Index Number 621.97 Riveting hammer

A PORTABLE tool known as the Syntron Electric Hammer is being manufactured by the National Electric Mfg. Co. It is suitable for drilling through masonry walls, light riveting and assembly work, or any other kind of work where a portable power hammer may be used. It uses either AC or DC current and needs only to be plugged into a socket to be ready for operation. No mechanical devices are used to operate the piston—the current alone producing the necessary movement. It can be furnished in 3 types.

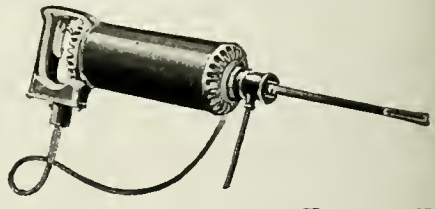

FIG. 1 PORTABLE ELECTRIC HAMMER FOR LIGHT DRILLING AND RIVETING

Type F weighs 9 lb. and has a drilling capacity up to ½ in. holes. Type A weighs 17 lb. and has a drilling capacity up to 1 in. holes. Type B weighs 26 lb. and has a drilling capacity up to 1½ in. holes.

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 150 magazines; it also includes the publications of some 50 book publishers and professional societies as far as these are of managerial interest to industrial executives. The items are prepared and classified by the Engineering Societies Library in New York City. The decimal number at the right of each item is the index number and indicates the place the article or book will take when filed in accordance therewith in the classified subject scheme. If articles are grouped according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. Photostat copies of any magazine article indexed can be supplied by The Ronald Press Company for a moderate charge. The books and pamphlets indexed can be procured from their respective publishers.

Accounting

Amortization. 657.42
B. L. Wheeler. *Industrial Management* (N. Y) March 1924, v. 67, pp. 163-66. The author states that the five-year period for filing claims does not expire until June 1924, and explains, for the benefit of industrial executives, some of the essential points with respect to amortization of war-time facilities.

Computing the Economies of Labor-Saving Equipment. 657.452
Power Plant Engineering, February 1, 1924, v. 28, p. 179. Points out that, in computing the value of labor saved, it must be charged with its share of overhead charges on both direct and indirect labor.

Determining the Selling Price 657.452
L. M. Waite. *American Machinist*, April 3, 1924, v. 60, pp. 495-497. How to arrive at a constant, or table of constants, that will enable the executive to know quickly and with certainty the "break-even" sales price of a machine or tool on which the shop cost is a known or carefully estimated number of dollars and cents.

Distribute Costs on Each Job. 657.452
E. C. Boehringer. *The Foundry*, March 15, 1924, v. 52, pp. 207-242. Routing work through the plant of the Nugent Steel Castings Co., which makes possible an elaborate cost system. Costs are kept of all material and labor consumed in the various departments and in special pieces of work.

Factory Overhead. 657.441
By Frank E. Webner. 456 pp. The White Press Company. Diagrams. The determination of the proportionate amount of overhead to be borne by each product has been one of the most baffling problems confronting manufacturing managements. Many different methods for attacking the problem have been proposed but even now there are only a few managements that have tested these proposed methods in a really scientific or practical manner. Possibly some of this hesitation has been caused by lack of definite knowledge concerning the practical application of various proposals. This book was written for the purpose of presenting the most useful information on every subject concerning cost finding that is of special interest to the manufacturer. It contains descriptions of numerous methods which have been developed in actual practice. The author explains the reason for each method, its particular application, and, where necessary, presents sample forms and charts to be used. The broad scope of the work is evidenced by the chapter headings which are, in part: Relation of Labor to Overhead; Industrial Classification; Overhead Diagnosis; Power Costs; Receiving and Transporting Material; Land Values and Building Space Costs; Maintenance; Methods of Departmental Segregation; and Specific Plans for Diffusion of Overhead. The work will be valuable to the executive who wants to learn how effective his present cost methods are; to the cost accountant who is seeking for improvement in his cost determination; to the student of accounting and cost finding; and to all others who are interested in the progress of modern management methods.

A Fallacy of Management. 657.452
B. M. Maynard and Johnson Heywood. *Factory*, March 1924, v. 32, pp. 330-331, 366. The fallacy of management that average costs are of any value applies to the manufacturer. The form this fallacy takes in different concerns is carefully discussed and proved in this article.

Industrial Cost Accounting for Executives. 657.452
Paul M. Atkins. *American Machinist*, March 13 and 20, 1924, v. 60, pp. 403 and pp. 433-435. One of a long series of articles. Makes the suggestion that the cost accountant check the papers and records of the planning department and also supply it with reports to guide it in making its plans.

Advertising

Advertised Trade Names under the Microscope. 659.1
John H. Cover. *Advertising Fortnightly*, March 12, 1924, v. 2, pp. 26, 36. A series of tests made to determine the advertising success of trade names.

Export Advertising Practice. 659.1
By Carl F. Propson. 271 pp. Prentice-Hall. To the American manufacturer wishing to enter foreign markets many serious problems are presented. A most important one is the determination of the proper advertising methods to use in stimulating demand for his products. In this book, Mr. Propson has given a comprehensive discussion of all phases of advertising abroad from preparation of the copy to checking of results. It is divided into two parts; the first section deals with the general principles of planning and placing the advertising campaign, and the second takes up a specific consideration of the tools and methods which may be useful in the work. The author says that although there is no difference in the basic principles of advertising the application of those principles in different countries varies considerably. As an example of this may be cited the general belief among American advertisers that their methods are nearly 15 years in advance of foreign advertising. Because of this, modern American advertising methods would not be appreciated in many countries where a plan of attack discarded here years ago might obtain splendid results. Because of the specific information it contains concerning the most successful export advertising practice the book should prove a valuable addition to the library of all who are interested in the subject discussed.

Little Stories of Big Trademarks. 659.1
H. E. Agnew. *American Industries*, March 1924, v. 24, pp. 17-20. Illus. See this entry under Management.

Measuring the Comprehension of Advertisements. 659.1
A. T. Poffenburger. *The Journal of Applied Psychology*, December 1923, v. 7, pp. 364-369. How much can the public get from the printed page? and to what degree does the copy-writer adjust his vocabulary to his audience? How to solve these questions, and some others, are covered in this article.

Newspaper Advertising that Paid. 659.1
W. P. Dwyer. *Brick and Clay Record*, March 4, 1924, v. 64, pp. 343-345. How a plant created a big market through advertising in daily newspapers.

Retail Advertising and Selling 659.1
By S. Roland Hall. 590 pp. McGraw-Hill Book Company. Illus. Although this book has been written for the retailer it contains much valuable information for manufacturers in general and especially to those that sell direct to retailers. The latter class will find valuable suggestions for assisting the retailer to sell their products. Both advertising and marketing is

treated in a manner which is almost as valuable to manufacturing executives as it is to proprietors of retail establishments. The book outlines methods used by a great number of successful firms and is profusely illustrated with sample advertisements, charts, sales letters, and similar material.

Building and Equipment

The Architect, the Contractor and the Industrial Builder. 658.2
J. P. H. Perry. *Buildings*, February 27, 1924, v. 61, pp. 465-469. Why industrial firms should employ architectural engineers when building, and not make the contractor serve alone.

Design and Maintenance of Factory Buildings. 658.2
H. Pearman. *Industrial Management* (London) February 21, 1924, v. 11 (new series), pp. 95-97. Gives brief suggestions for the arrangement of machinery sections to facilitate the smooth flow of work, and for the suitable location of the various subsidiary departments in the layout of the plant.

Factories in the Country. 658.2
Silas Bent. *The World's Work*, March 1924, v. 67, pp. 529-533. A readable article describing some model country plants which have been built with the idea of giving workers attractive surroundings, fresh air, and sunshine.

Fire Protection in Building Design. 693.81
E. A. Barrier and J. O. Taber. Boston Society of Civil Engineers, March 1924, v. 11, pp. 85-108. Types of interior construction from the fire standpoint, the use and limitations of incombustible materials, as steel, reinforced concrete, etc., partitions, fire-walls, protection of stairways and elevator shafts, and protection from outside exposure.

Floors for Railway Buildings. 658.23
Railway Review, March 15, 1924, v. 74, pp. 498-499. Appendix B: Report of Committee VI—Buildings. American Railway Engineering Association. Summarized data of floors commonly used in the various kinds of buildings.

Mechanical Painting Saves Labor. 698
C. C. Fredericks. *Railway Engineering and Maintenance*, March 1924, v. 20, pp. 101-102. The fundamentals of machine painting. What the painter must know, what materials may be applied, durability, appearance, and number of coats needed.

Modern Maintenance of Plant and Equipment. 658.2
W. G. Ziegler. *Industrial Management* (N. Y.) March 1924, v. 67, pp. 167-174. Illus. Discusses in detail floors, stairs, stock racks, partitions, machine foundations, walls, machine repair, etc., with regard to the most satisfactory materials to be used, and the inspection and maintenance necessary.

The New Competition and Your Building. - 658.2
3. Economic Aspects of Building Operations. W. F. Ballinger. *Industrial Management* (N. Y.) March 1924, v. 67, pp. 140-44. The importance of preliminary planning; the best time to build; the value of good architectural service in the planning and equipment of structures.

Organization and Construction of Woolen Mills. 658.2
W. A. Benoit. *Mechanical Engineering*, April 1924, v. 46, pp. 208-211. Paper at the annual meeting of the American Society of Mechanical Engineers, 1923. Deals with mills which are complete units, making woolen yarn, and weaving and finishing the cloth. Takes up factors to be considered in location, type of building, arrangement of departments, and provision for water and power. Followed by discussion.

Paints for Railway Buildings. 698
Railway Review, March 22, 1924, v. 74, pp. 557-559. Appendix C: Report of Committee VI—Buildings. American Railway Engineering Association. Recommends: When to paint, What paints to use, and How to apply them.

Profits from Better Equipment. 658.27
W. R. Basset. *Management and Administration*, April 1924, v. 7, pp. 437-439. There is no greater sale advantage than a low price based upon a low production cost. Prompt adoption of improved machinery is business assurance. The concern which replaces its equipment as soon as better is devised is nearly always more profitable than the one that waits for its equipment to wear out before making replacements.

Where Shall He Park It? 658.237
National Safety News, February 1924, v. 9, pp. 17-18. How a few companies handle the problem of parking employees' cars both inside and outside the plant.

Commerce

Essentials of International Trade 382
By Simon Litman. 398 pp. John Wiley and Sons. To a great many American manufacturers foreign trade is more or less of a mystery although they are beginning to realize that in the development of foreign markets lies the solution of the problems arising from fluctuating domestic demands. This book was written primarily as a textbook and so will be easily understandable to those with little previous knowledge of the subject. The first part of the work deals with the public aspects of international trade and covers foreign investments, customs regulations, commercial treaties, governmental activities, and trade promotion. The second part considers the private aspects of the subject and goes into considerable detail concerning the specific tools and mediums which are of use in establishing and retaining commercial relations with foreign buyers and sellers. All discussions are concise, and although clear to the beginner are sufficiently complete to be of value to the business man actively engaged in export or import trade.

A New Index of Business Activity. 38(001)
C. Snyder. *Journal of American Statistical Association*, March 1924, v. 19, pp. 36-41. Charts. This new index covers all the different fields of productive activity, primary distribution, distribution to consumer and financial and general business activity.

Our Imports and Who Use Them. 382
O. K. Davis. *American Industries*, March 1924, v. 24, pp. 11-15. Illus. A most instructive article showing how completely we are surrounded by things imported in our daily life at home as well as in business.

Economics

Amortization. 336.24
B. L. Wheeler. *Industrial Management* (N. Y.) March 1924, v. 67, pp. 163-66. See this entry under Accounting.

Confidence, Credit and Enterprise. 332.7
Theodore Rich. *Cassiers Industrial Management*, March 6, 1924, v. 11, pp. 130-131. Shows how the significance of credit is often lost sight of and that Confidence, Credit and Progress are interlocked.

Credit Insurance. 368.8
J. T. Burke. *Paper Trade Journal*, February 14, 1924, v. 78, p. 66. Emphasizes the need for an industry to insure against losses from bad debts. Explains how this kind of insurance is taken out.

The Customs Service. 337
By Lawrence F. Schmeckebier. 191 pp. The Johns Hopkins Press. The Institute for Government Research has undertaken the preparation of a series of monographs giving a detailed description of the organization and services of various governmental departments and bureaus. The present study contains a description of the Customs Service. It, like all the Institute's monographs, gives, in order: the history of the service; its functions; its organization; reference to its governing laws and regulations; and a bibliography of sources of information concerning it. The particular interest of this book to manufacturers lies in the description of the Customs Services' control over export, imports, and shipping. To the manufacturer engaged in foreign trade this information should be of considerable value.

Factors Affecting Wages and Other Shares in the Product of Industry. 331.2
F. C. Mills. *Management and Administration*, April 1924, v. 7, pp. 423-426. The nature of the wage problem is explained by presenting the general background of the problem of distribution, describing the nature of forces which affect the division of the product of industry, and indicating the importance of certain basic requirements.

Industrial and Financial Investigations. 332.7
Arthur Anderson. National Association of Cost Accountants. *Official Publications*, April 1, 1924, v. 5, no. 14. Investigations from the viewpoint of safeguarding the purchase of securities in connection with the financing of a business.

Keeping America for Americans with Machines instead of with Aliens. 331.6
R. B. Williams. *Manufacturers' Record*, March 6, 1924, v. 85, pp. 97-99. Need for greater restriction on immigration, to bar the foreigner who is inefficient as a workman and unassimilable as a citizen.

Die Preisbildung nach dem Banklassenverfahren. 338.5
J. Kirschner. *Maschinenbau*, February 14, 1924, v. 3, pp. 253-254. Value of accurate, quick, and simple methods of determining the influences that cause alterations in price building factors. Methods are discussed.

Prime Costs in the Business Cycle. 338.5
Alvin H. Hansen. *Journal of Political Economy*, February 1924. A practical analysis of industrial cost factors as affected by the business cycle.

Produktionsverhältnisse der mechanischen Industrien in Österreich. 338(436)
O. Taussig. *Zeitschrift des Vereines Deutscher Ingenieure*, March 8, 1924, v. 68, pp. 209-211. Surveys Austria's industrial condition since the war.

A Recommendatory Minimum Wage Law. 331.215
Arthur F. Lucas. *American Economic Review*, March 1924, v. 14, pp. 39-51. A survey of the first year's operation of the Massachusetts minimum wage law. The experiment proves that a law which compels acceptance of the rates is undoubtedly to be preferred to one which does not.

The Theory of Quadrature in Economics. 338.97
K. G. Karsten. *Journal of American Statistical Association*, March 1924, v. 19, pp. 14-29. Charts. Charles N. Edge developed the "Quadrature Theory" which states that "the time lags between cycles in various economic phenomena are functions of the periods of these cycles." The author expounds this theory in relation to forecasting economic conditions.

We Should Know More about Our Business. 338
I. S. Paul. *Textile World*, February 2, 1924, v. 65, pp. 193-194. Necessity of balancing production and consumption, of market analysis, and accurate statistics of all industries.

Your Banker's Attitude toward an Application for Credit. 332.7
W. A. Mitchell. *The Canadian Manufacturer*, March 1924, v. 44, pp. 27-29. Who is entitled to credit and how to obtain it. Discusses credit for the farmer, the manufacturer, exporter and importer, merchant, municipalities, etc.

Financial Control

Control of Fixed Property Investments. 658.14
J. H. Bliss. MANAGEMENT AND ADMINISTRATION, April 1924, v. 7, p. 405. The fifth article in the series covering capital requirements and control. Fixed property investments are treated as accounting problems and as studies in financial control.

Fundamentals of Business Management. 658.14
W. S. Kemp. *Official Publications*, National Association of Cost Accountants, March 15, 1924, v. 5, pp. 10-19. Some practical suggestions as to financial control showing what accounts should control the investments made and the activities of the business in general.

How and to What Extent Should Detail Cost Information be Given to Department Heads? 658.14
G. M. Pelton. *Paper Trade Journal*, February 28, 1924, v. 78, pp. 55-58, 60. Why cost information is needed by those responsible for the buying, production, and selling functions.

Pricing Policy Applied to Financial Control (Tables). 658.14
Donaldson Brown. MANAGEMENT AND ADMINISTRATION, April 1924, v. 7, pp. 417-422. An exhaustive study of price analysis. Such an analysis is closely interwoven with the matter of financial control, since the expression of price policy, in terms of rate of return attainable on capital employed, is the most significant factor bearing upon the question of availability of capital for purposes of operation.

Fuel

The Better the Coal the Less is Used. 662.65
C. C. Hermann. *Black Diamond*, March 22, 1924, v. 72, pp. 328, 360. Value of fuel ratio method in comparing coals, importance of watching ash and fixed carbon, common sense firing and necessity of studying sizes.

Burning Low-grade Fuels in Pulverized Form. 662.6
E. K. Scott. *Colliery Guardian*, March 7, 1924, v. 127, pp. 607-608. Comparative figures are given showing use of pulverized fuels in the U. S. and other countries.

Conditions that Will Make Gas the Ultimate Fuel. 662.6
F. W. Parsons. *Gas Age Record*, March 15, 1924, v. 53, pp. 317-18, 321. Considers the increase in economy of coal output as a result of the use of mechanical loaders and conveyors; and the use of oil as a substitute for coal, and its limitations.

Economic Aspects of Liquid Fuel. 662.75
W. R. Quinn. *Combustion*, March 1924, v. 10, pp. 197-199. Economic survey of petroleum production in the U. S. with statistical information covering production and use for the last few years.

Oil Uncertain as to Supply and Price. 662.75
Black Diamond, March 22, 1924, v. 72, pp. 350-351. A statistical article valuable for the man who is contemplating a change from coal-burning equipment to oil-burning equipment.

Pulverized Fuel and Efficient Steam Generation. 662.6
D. Brownlie. *Gas Engineer*, February 1924, v. 40, pp. 29-30. Advantages of using pulverized coal in the steam-boiler plant.

Management

Classification and Subject Headings for Business 025.4
Compiled by Fremont Rider. 333 pp. Cumulative Digest Corporation. When the work of editing *Business Digest* was commenced in 1916 there was found to be no system of subject headings to cover the literature of business. To meet this need the system of subject headings contained in this volume was started and grew by accretion and revision in daily use during the next five years. The decimal classification was formulated more deliberately from the subject headings. The compiler realizes that both the classification and subject headings are incomplete, but they proved valuable in their five years' use and are more complete than any previous compilation in the field. Sections on banking, advertising and sales promotion, and store management are worked out in considerable detail while other branches of business are only outlined. Although the classifications may not be complete enough for general use the work will be of great value to anyone preparing a similar index system.

Economy of the Chain Invoice System. 658.773
Elton Johnson. *Canadian Manufacturer*, February 1924, v. 44, p. 44. A cumulative invoice repeating with each succeeding invoice the items and amount on the previous record. System is in use in one of Toronto's largest manufacturing concerns.

How to Avoid Inadvertent Patent Infringement. 608(007)
H. A. Toulman. *Factory*, March 1924, v. 32, pp. 324-325, 376. Author is a patent attorney. Eight "rule-of-thumb" guides in matters of infringement are given and many cases cited that illustrate the fine distinctions between lawful and unlawful practice.

Increasing Production and Decreasing Costs. 658
Guy H. Rumpf. *Western Machinery World*, February 1924, v. 15, pp. 50-52. General remarks on some of the factors bearing on production, including plant, material, the employment of men, the ideal foreman, management, standard time, wages, and cost system.

Little Stories of Big Trademarks. 608
H. E. Agnew. *American Industries*, March 1924, v. 24, pp. 17-20. Illus. Distinctive

designs, easily recognized, easily pronounced, and capable of reproduction in a wide variety of forms, have been the means of carrying products to millions with corresponding returns.

Management Engineering. 658
By P. F. Walker. 356 pp. McGraw-Hill Book Company, illustrations, charts and diagrams. The author, who is Dean of the School of Engineering, University of Kansas, has written this book primarily for classroom work, therefore it contains considerable elementary information. The first part considers the design and layout of the manufacturing plant. The factors influencing the location, the design of the buildings, and the placement of equipment, are discussed at length with some interesting and useful methods for solving scientifically certain design problems that are always confronted. The second part deals with the organization and administration of the plant. Organizing and financing a company is considered first and then the author discusses executive control, operating methods, and costs. An appendix contains general information regarding contracts and illustrative forms in company organization. Although there is nothing particularly new in the book, seldom does one find in a single volume authoritative information on so many subjects of interest to the manufacturing executive. Inasmuch as the methods described are in conformity with the best modern management practice, it will prove a convenient and valuable reference book on Administration and Management.

The Originating Function in Management. 658
John Calder. *The Society of Industrial Engineers Bulletin*, February 1924, v. 6, pp. 4-9. The underlying philosophy and psychology of the origination of sound business ideas and policies—the qualities of mind and character demanded for business preparedness.

Possibilities of Modern Management from a Banker's Standpoint. 658
Gordon Wilson. *Society of Industrial Engineers Bulletin*, January 1924, v. 6, pp. 3-4. Management from a banker's viewpoint. Shows how *character* is the basis and cause of management, and *capacity* is demonstrated ability in management.

Practical Experience in Modern Business Correspondence. 651.7
By Hiram N. Rasely. 95 pp. Boston Chamber of Commerce. Many manufacturing organizations depend almost entirely upon correspondence for forming contacts with the buying public. Because of this it is not surprising that increasing emphasis is being placed on the construction of the letters from which the reader will gain his strongest impressions of the writer's organization. This book is a valuable addition to the list of articles on business correspondence. The material has been prepared under the direction of a committee of the Boston Chamber of Commerce and is decidedly practical. Nearly half of the contents consists of extracts from and examples of letters which have been actually tried and found to be successful. It is worth reading by anyone who writes letters.

Production Organization. 658.16
N. Gerard-Smith. *Engineering Production*, March 1924, v. 7, pp. 74-77. An analytical, but practical article covering the essentials of factory organization.

Research—A Mental Attitude. 6(072)
C. F. Kettering. *Michigan Manufacturer and Financial Record*, March 1924, v. 33, pp. 6, 31. "The mental attitude" in this article is the business or dollars and cents attitude. Does not take up research from a scientific viewpoint but rather as a means for removing perfectly apparent obstacles.

Standardization—What It Is Doing for Industry. 6(003)
23 pp. American Engineering Standards Committee. This booklet presents a review of the necessity of standardization in industry; what has been accomplished; what is proposed for the future; and what agencies will carry on the work.

Two New National Services to Industry. 6(003)
Dr. George K. Burgess. *American Machinist*, March 20, 1924, v. 60, pp. 417-419. The Federal Specifications Board of the Bureau of Standards now has 60 technical committees at work on such subjects as lubricants, metals, textiles, wire rope, coal, fire extinguishers, etc. The specifications fixed by this board become the official government standard for use in the purchase of all material covered by the specification. The new Dictionary of Standards now being compiled by the Bureau is reviewed and its scope is outlined.

Über Wissenschaftliche Arbeit und Forschung in der Maschinenindustrie. 6(072)
G. Lippart. *Zeitschrift des Vereines Deutscher Ingenieure*, February 2, 1924, v. 68, pp. 89-93. A survey of industrial research in Germany, especially as affecting mechanical engineering. Comments on similar progress made in the United States, and German inability, because of its present plight, to conduct research on as large a scale.

Management of Special Industries

Building 80 Cars a Day. 658.9 : 629.113
H. P. Armson. *Canadian Machinery*. February 14, 21, 1924, v. 31, pp. 13-19 and pp. 13-17. Illus. Assembling methods employed, and special material handling equipment used in the new Ford Motor Company plant in Toronto.

Chevrolet Tarrytown Plant Assembles 600 Complete Cars a Day. 658.9:629.113
Herbert Chase. *Automotive Industries*. March 20, 1924, v. 50, pp. 666-671. Gives in detail the whole assembly scheme of the plant, with a full page chart showing layout of the chassis assembly and open body manufacturing facilities.

Mechanical Engineering in Colliery Operations. 658.9:622
Sir William Ellis. *Mechanical World*, February 8, 1924, v. 75, pp. 82-83. The extensive and varied character of modern colliery machinery fully justifies the presence of a well-trained mechanical engineer on the staff of a colliery.

Methods for Analyzing Raw Materials. 66(072)
(Data Sheet). R. Rimbach. *Forging, Stamping and Heat Treating*, March 1924, v. 10, p. 124-a. Covers coke oven by-products and heating and waste gases.

Planning System in a Car Manufacturing Plant. 658.9:625.2
Railway Review, March 1, 1924, v. 74, pp. 357-365. Illus. System of scheduling car repair work in the shops of the Ralston Steel Car Company, Columbus, O.

Welding Standardization in Locomotive Shops. 658.9:625.2
J. S. Heaton. *Railway Mechanical Engineer*, March 1924, v. 98, pp. 176-178. Illus. Various methods used on boilers, fireboxes and running gear. Includes standardization of equipment, layout of a welding shop, and special instructions for welders.

What Dealer Distribution Means. 658.9:666.7
F. L. Steinhoff. *Brick and Clay Record*. February 19, 1924, v. 64, pp. 252-255. Illus. Charts. See this entry under Selling.

Mechanical Handling

Coal and Ash Handling Systems for Power Plants. 658.281:662.65
J. W. Geiger. *National Engineer*, February 2, 1924, v. 28, pp. 53-56. Describes the various types of elevating and conveying machines, and considers the applications and limitations of each.

Coal and Coke Handling Plant in Gas Works. 658.281:662.65
Herbert Blythe. *The Gas Engineer* (English) January 1924, v. 40, p. 9. Illus. Describes telpher systems used by several gas works that have solved difficult coal-handling problems.

Coal-Storage Systems. 658.281:662.65
H. E. Birch and H. V. Coes. *Mechanical Engineering*, April 1924, v. 46, pp. 189-196. Considers spontaneous combustion, the means of unloading railroad cars and boats, and the advantages and disadvantages of the various systems of storage. Enumerates the conditions of the ideal storage plant.

A Conveyor System that Revolutionized a Cotton Mill. 658.281:677
R. T. Kent. MANAGEMENT AND ADMINISTRATION, April 1924, v. 7, p. 411. Illus. The author has traced the progress of material through the mill from raw cotton to finished cloth, and has described in detail the conveyor systems in use. A full page chart gives the arrangement of con-

veyors, chutes, and elevators at the Jackson Mills at Nashua, N. H.

Elimination of Accidents by the Use of Conveyors. 658.281
F. D. Campbell. *National Safety News*, March 1924, v. 9, pp. 41-42. Enumerates many applications of conveyors in the movement of raw or finished products and in actual processes of production, and shows how their use minimizes fatigue and reduces accidents.

Handling Sulphate of Ammonia in a Modern Gas Works. 658.281
E. W. Rainer. *The Gas Engineer* (English) January 1924, v. 40, pp. 13-14. Describes in detail the conveyor system in the tar and ammonia products works of the Gas, Light and Coke Co.

Modern Material Handling in Gas Works. 658.281:662.65
The Gas Engineer (English), January 1924, v. 40, pp. 11-12. Illus. Discusses coal handling devices, their construction and the latest improvements in each. Special attention is paid to the heavy unloading cranes, 10 of which are being installed on the Thames.

Transportation Applied to Factories. 658.281
R. B. Williams. *Canadian Manufacturer*, February 1924, v. 44, pp. 23-24. Illus. Economies made through the application of electric hoists. Cites specific plants where hoists are used and gives an account of their yearly savings, including maintenance.

Transportation as Applied to Manufacturing Plants. 658.2812
R. B. Williams. *Western Machinery World*, February 1924, v. 15, pp. 65-66. "The ability to move objects is the determining factor in the progress of industrial concerns." Points out the particular value of the electric hoist.

Uses Gasoline Locomotives and Small-Unit Cars. 658.281
J. S. Shiely. *Cement, Mill and Quarry*, March 20, 1924, v. 24, pp. 37-38. Describes the application of the narrow-gage industrial railway to conveying material from pit to plant by the Shiely Sand and Gravel Co., St. Louis.

What Has a Railway a Right to Expect from Mechanical Equipment? 658.28
Earl Stimson. *Railway Engineering and Maintenance*, March 1924, v. 20, p. 92. Requirements which must be met before a road is justified in purchasing machinery. Limited to portable machines which are listed, but no special type recommended or described.

Mining

Applications of Electricity in Crushed Stone Industry. 622.35
E. W. Pilgrim. *Cement, Mill and Quarry*, March 5, 1924, v. 24, pp. 23-24. Touches on the source of power; the equipment of the transformer substation; the lightning transformer; the motors used for continuous conveyors, for crushers, and for shovels for loading quarry cars, and the use of the storage battery locomotive for hauling stone from the quarry to the crushers.

Mine Rescue Apparatus. 622.8
Iron and Coal Trade Review, March 7, 1924, v. 108, p. 381; March 14, 1924, v. 108, pp. 430-431. Illus. Third and final report of Mine Rescue Apparatus Research Committee. It deals principally with the use of liquid air and liquid oxygen in mine rescue apparatus and includes a description of the improved Aerophor apparatus.

Notes on Underground Transport. 622.6
A. Rees. *Iron and Coal Trades Review*, February 22, 1924, v. 108, p. 307. Analysis of haulage costs comprises capital cost, working cost, maintenance and general supervision.

Running a Moderate-Sized Quarry Plant. 622.35
R. N. Van Winkle. *Cement, Mill and Quarry*, March 5, 1924, v. 24, pp. 21-23. Advocates the moderate-sized plant supplying a limited territory in preference to the large plant supplying a wide area.

"Safety First" in the Mine. 622.8
Colliery Guardian, February 15, 1924, v. 127, pp. 403-404. A collection of mining "posters" issued by the British Industrial "Safety First" Association. Relate to haulage operations and roof support, also general directions. Slogans are included.

Some Researches on the Safe Use of Electricity in Coal Mines. 622.91
W. M. Thornton. *Colliery Guardian*, February 15, 1924, v. 127, pp. 407-408. A continuation of article in February 1 issue. This concluding number is followed by discussion.

Squeezing Out the Little Fellow. 622.33:338
Black Diamond, March 1, 1924, v. 72, p. 239. Compares the position of the large and the small operator in the coal mining industry. Recommends as a solution of present difficulties greater unification of ownership.

Personnel

Apprenticeship and the Employer. 658.3861
S. Scrimshaw. *Open Shop Review*, March 1924, v. 21, pp. 114-122. Apprenticeship, the best way to obtain trained and efficient labor, develops pride in the workman's craft. Employed educators in the plant have been proved worthwhile. Accident rate low among trained workmen.

Employee Representation. 658.31514
J. H. Vertrees. *American Management Review*, March 1924, v. 13, p. 7. Some warnings as to control of committee policies. Functions of such committees should be definitely fixed and so safeguard against misinterpretation of its authority.

Eye Tests in Industry. 658.38222
Eyesight Conservation, Bulletin no. 3, 1923. 11 pp. Instruction for testing visual acuity. Discusses vision charts, recording of results of tests and value of such testing in industry.

Finding the Right Man for the Job. 658.31255
B. S. Beach. *Cassiers Industrial Management*, March 6, 1924, v. 11, p. 126. Employees' records are kept which so well tell the story of the workers' qualifications that vacancies can be filled from the ranks as soon as they occur. Forms are given.

Human Factors at Cash Register Plant. 658.38
Iron Age, March 20, 1924, v. 113, p. 843. Illus. How welfare work has been developed at the plant of Dayton. Lunchrooms, restrooms, profit-sharing plans, apprentice systems, etc., are described.

Ideal Piecework Plan. 658.3231
E. Bouton. *Abrasive Industry*, February 1924, v. 5, pp. 33-35. Payment plan worked out on a basis of group piecework.

Industrial Health. 658.3822
Edited by George M. Kober and Emery R. Hayhurst. 1184 pp. P. Blakiston Sons and Co. Illus. With the present high wages it is very important that adequate labor return be obtained; and to obtain such a result the workers' physical condition must be good. Illness, accidents, fatigue, and high labor turnover all influence the quality and quantity of production and so are of great interest to the employer. In this work the editors have brought together comprehensive data of industrial efficiency which may be obtained through personal efficiency and the intelligent and scientific control of the environment in the workshop and the home. In the numerous chapters, contributed by 35 authorities, all phases of industrial health are covered in detail. Although written by scientists the book is, for the most part, written in the language of the lay person. The book is divided into five parts. Part I is titled General Principles of Maintaining Health in Industry, and gives practical usages for general application. Part II considers the vocational hygiene of certain industries and callings, such as mining, iron and steel manufacturing, etc., which are of enough importance in our industrial life to deserve special attention. Part III contains information about the causes, results, and preventatives for specific occupational diseases. Part IV covers systematic occupational diseases and is rather medico-technical. Part V considers the general principles of industrial health administration and discusses vital statistical findings, and legislative, administrative, and compensative features of industrial health.

Meeting the Industrial Problem. 658.38
W. M. McLaurine. *Textile World*, February 23, 1924, v. 65, pp. 21, 100-101. Illus. The story of the Bibb Mfg. Co., a big cotton mill organization in Bibb City,

Ga., which created a community spirit among its employees.

Method of Rating Employees at Cheney Plant. 658.31255
Textile World, March 22, 1924, v. 65, pp. 29-30. Describes the hiring specifications worked ont by Cheney Bros., and a system of credit rating which gives the employee some part in adjusting his own pay.

The Personal Relation in Industry. 658.3
By John D. Rockefeller, Jr. 149 pp. Boni and Liveright. This is a collection of addresses delivered by Mr. Rockefeller on various occasions in which he presents a clear view of his attitude on the capital versus labor controversy. He believes the two are partners and that industry should be organized to express that relation. A concrete example of his attitude may be found in the reorganization of the Colorado Fuel and Iron Company to give the employees a voice in the management. In the preparation and installation of this new plan of employee representation Mr. Rockefeller was an active worker. The industrial constitution which was adopted is given in the appendix.

Productivity of Labor. 658.3811
Monthly Labor Review, March 1924, v. 18, pp. 101-102. Some figures resulting from an inquiry to determine the comparative output under 10-hr. and 8-hr. shifts in glass factories in England.

Science and Management. 658.3
H. A. Richmond. *American Management Review*, March 1924, v. 13, pp. 5-6. A plea that the same scientific methods of research now used for materials and physical processes be applied to the analysis of men.

Selecting Employees to Fit the Needs of the Foreman. 658.3
T. G. Portmore. *American Management Review*, March 1924, v. 13, pp. 3-4. Essential that the employment manager should work in sympathy with the foreman. The foreman is a valuable man in imparting to the personnel the education he receives daily in the school of practice and this asset should not be discounted by the manager but encouraged.

What 86 Years Have Taught Us about Selecting Labor. 658.3
Horace B. Cheney. *Factory*, April 1924, v. 32, pp. 496-498, 598, 600, 602, 604-605. A survey which covers all phases of personnel and production, including intelligence tests, comparative analysis of production as affected by length of service, and a method of credit rating.

What Makes Employees Differ? 658.311562
D. A. Laird. *Industrial Management* (N. Y.) March 1924, v. 67, pp. 184-90. Results of psychological tests which show that individual differences in mental capacities are modified but little by training and environment, that training simply gives one the ability to do a certain kind of work.

Power Control

Cost of Generating Steam. 658.26
Einar Winhott. *National Engineer*, March 3, 1924, v. 28, pp. 115-116. Briefly describes simple methods of determining costs, and points out that continnous cost records serve as a check on boiler plant performance.

The Engineer and his Compensation. 658.26
W. H. Wakeman. *National Engineer*, February 2, 1924, v. 28, pp. 68-70. Cites several instances which illustrate how the engineer in a plant can increase economy in operation, and how appreciation and reward from his employer enlist his interest and co-operation.

Plant Two Power House. 658.26
F. J. Crolius. *Blast Furnace and Steel Plant*, March 1924, v. 12, pp. 142-147. Third article on the Inland Steel Company. Describes the concentration of motor drive and treats in detail the operation and control of the electrical power equipment in the various departments of the plant.

Reducing Steam Production Costs. 658.26
H. M. Burke. *National Engineer*, March 3, 1924, v. 28, pp. 100-106. Details of a system worked out in the power department of a large textile finishing concern, which makes possible daily examination of plant operation.

Wanted: a Policy in Industrial Power Plants. 658.26
Douglas Henderson. *Power Plant Engineering*, February 15, 1924, v. 28, pp. 228-30. How neglect of the power plant results in losses to an industry, and how a power policy permits the formulation of a plan which serves not only for present needs, but also as a guide for future improvements.

When to Use Group and Individual Drives. 658.26
R. W. Drake. *Industrial Engineer*, March 1924, v. 82, pp. 118-122. Illus. Gives reputed advantages of group drives and makes comparisons between the investment and operating cost of group and individual drives.

Production

Accuracy in Production Engineering. 658.5
J. E. Baty and A. J. C. Brookes. *Engineering Production*, February 1924, v. 7, pts. 1-2, pp. 48-56 and March, pp. 64-69. A technical article giving some developments in measuring and the latest scientific advancement in practical measurement in its application to economical quantity production.

Defects in Modern Production Machine Tools. 658.581
Thomas Nadin. *Canadian Machinery*, February 28, 1924, v. 31, pp. 19-20. Illus. Treats of inefficient lubrication of bearings and cutting tools. Discusses inspection, cleanliness, oil storage, and construction of tanks.

Distribution Costs on Each Job. 658.5
E. H. Boehringer. *Iron Trade Review*, March 27, 1924, v. 74, pp. 853-857. Illus. Plan of detail cost tabulation in use at the Nugent Steel Castings Co. All expenses, including minor materials, are charged to each job. Straight line routing is employed and other operation practices described.

Effecting Economies by Regulating Work Flow. 658.51
A. Whitehead. *Industrial Management* (London) February 21, 1924, v. 11 (new series), pp. 98-99. Suggests a system for recording the state of orders and deliveries of raw materials, and emphasizes the importance of having the supply of materials and plant adequacy constantly examined and made secure, in order to insure the necessary production.

The Fatigue Element in Accident Prevention. 658.544
W. Baum. *Railway Mechanical Engineer*, March 1924, v. 98, pp. 181-182. Charts. Accidents vary in direct proportion to fatigue. The problem of the human machine surpasses in importance that of mechanical devices and should receive scientific attention, thus minimizing fatigue and accidents.

The Fundamentals of Cost Reduction. 658.51
H. Kerr Thomas. *Cassiers Industrial Management*. March 6, 1924, v. 11, pp. 123-125. Aims to show how prices may be reduced and quality maintained. Starts with five elements, which make up the price of any manufactured article and shows wherein savings can be made.

Handling Production Problems. 658.5
H. A. Lowell. *Textile World*, February 16, 1924, v. 65, pp. 51, 53, 114 (continued), Charts. Installation of planning department in a hosiery mill to keep machines busy and finish right assortment of goods on time. A thorough analysis of production control from purchasing of raw materials to control of sales in excess of the manufacturing capacity.

How We Can Save $10,000,000,000? 658.516
Wm. A. Durgin. *Trade Winds*. March 1924, pp. 9-11, 24. Reduction of variety in sizes and immaterial differences of every-day commodities as a means of eliminating waste, decreasing costs, and increasing profits in all lines of industry. How the government can aid in this simplification by making surveys to fix facts and applying them.

Machining Pulleys on a Big Production Basis. 658.581
A. E. Granville. *Canadian Machinery*, February 7, 1924, v. 31, pp. 27-30. Illus. Methods employed by different shops according to various equipments.

Maintaining a Profit with Reduced Prices. 658.5
E. A. Munschauer. MANAGEMENT AND ADMINISTRATION, April 1924, v. 7, pp. 401-404. Charts. How a firm building refrigerators achieved a 50 per cent increase in capacity by adopting workable methods of production control. Wage-incentive methods worked out by means of time studies, and a simple method of production control are described.

Making and Using Time Studies. 1. The Formulation of Policies. 658.5421
H. K. Reed. *Industrial Management* (N. Y.) March 1924, v. 67, pp. 145-49. Takes up the two forms of time study, standardization, determination of standard times, analysis of work, and the need for establishing a clearly defined routine through which the time-study unit is to function.

Making the Most of the Small Shop. 658.5
7 pp. Metropolitan Life Insurance Company. Consists of a brief statement of the necessity for complete information regarding production requirements and an outline of one method for obtaining it.

Management in the Metal Working Trades. 658.5
R. T. Kent. *Mechanical World*, February 22, 1924, v. 75, p. 112. Mechanical engineering applied to the design and output of the product, to the layout of the plant and to the maintenance of plant and equipment, is the foundation necessary for good management.

New Methods of Production Planning that Make Heavy Stocks Unnecessary. 658.51
Vice-President of a large machine tool company. *Factory*, April 1924, v. 32, pp. 480-482, 528. Charts. A method especially adapted to the "job-shop". The sum total of the whole operation is the starting point for planning. The purpose of this is that the part requiring the least time reaches the assembly floor at the same time as the part taking the longest time.

New Use for Refuse Refractory Material. 658.5671
S. F. Walton. *The Iron Age*, March 13, 1924, v. 113, pp. 786-88. A method of utilizing broken fire-brick from old furnace construction.

Organization of the Accounting Division. 658.5
F. A. Waldron. MANAGEMENT AND ADMINISTRATION, April 1924, v. 7, pp. 427-430. Time tickets, pay-roll, analysis sheet, requisition on stores, worked materials requisitions, are the forms described to show the accounting method which will give the most direct information with the minimum of clerical labor. Believes the chief value of a shop accounting system is so to classify expenditures that each portion of the product is carrying its proper share of the burden.

Precision Grinding Operations. 658.5
F. B. Jacobs. *Abrasive Industry*, February 1924, v. 5, pp. 29-33. Illus. (To be continued). See 621.92.

The Production Engineer. 658.53
A. Whitehead. *Mechanical World*, February 15, 1924, v. 75, pp. 103-04. Suggestions for forms to be used in production control, which serve to give orders to shops to do certain work, to describe methods, to insure supplies of materials, tools, etc., to record the progress of work, and to ascertain the cost of work done.

Repair and Upkeep of Pneumatic Tools. 658.582
R. W. Wilson. *Engineering* (London), February 15, 1924, v. 107, pp. 219-220. Illus. Charts. Enumerates sources of trouble and gives advice on how breakdowns may be prevented or repaired.

Standard Data Sheets for Machine Tool Builders. 658.58
A. L. Evans. *American Machinist*, March 13, 1924, v. 60, p. 381. See this entry under Technical.

Standardization Reduces Production Costs. 658.5
J. A. Murphy. *Forging, Stamping and Heat Treating*, March 1, 1924, v. 10, pp. 115-118. The president of Fayette R. Plumb, Inc., tells how intensive advertising and standardization has affected production problems on mechanics' tools.

Ten Small Savings Often Net Us More than One Large One. 658.5
C. C. Chesney. *Brass World*, February 1924, v. 20, pp. 39-42. Illus. How the Pittsfield Works, General Electric Co., derived big savings by reducing the cost of detail operations, and by applying labor-saving devices valuable in foundry practice.

Time Study and Standardization. 658.516
G. C. Brown. MANAGEMENT AND ADMINISTRATION, April 1924, v. 7, pp. 431-436. This third article in the series is a study of the subject as applied to the small factory. Points out the pitfalls in carrying out studies in the small plant, but believes the benefits of standardization are identical with those experienced in a medium or large organization.

Selling

Editing the Successful House Organ. 658.826
R. B. Williams. *Black Diamond*, March 8, 1924, v. 72, pp. 270-271. Emphasizes the importance of building good-will and prestige, and of developing the reader's interest by discussing not only the advertised product but also questions of general character.

Fundamentals of Business Management-Sales. 658.8
F. L. Sweetser. *Official Publications*, National Association of Cost Accountants, March 15, 1924, v. 5, pp. 3-6. A discussion of the training of salesmen, sales territories, and valuation, sales budgets (quotas) and sales expenses.

How Association of National Advertisers is Studying Distribution Costs. 658.821
P. L. Thomson. *Printers' Ink*, March 13, 1924, v. 126, pp. 117-121. See this entry under Advertising.

Reduction of the Cost of Sales 658.8
C. E. Shaw. *Official Publications*, National Association of Cost Accountants, March 15, 1924, v. 5, pp. 7-10. A study of planning as applied to the salesmen's work which was undertaken by the Dennison Manufacturing Co. with the idea of reducing the cost of distribution.

The Salesman with Too Much Territory. 658.808
V. V. Lawless. *Advertising Fortnightly*, March 12, 1924, v. 2, pp. 15, 32. A salesman's territory must be regulated by the frequency with which calls should be made. How the territory may be cut with fairness to the salesman as well as the house.

The Training of Salesmen. 658.807
Prepared by Sales Executive Division of the American Management Association. 190 pp. A special committee of the Sales Executives Division of the American Management Association was given the task of preparing this report on the best methods of salesman training. The purpose of the report is to answer three questions: Why should salesmen be trained? What should they be taught? How should they be trained? To answer these questions salesman training methods of 51 sales organizations have been obtained and their guiding principles consolidated into the first part of the report. In the second section outlines are given of the methods used by the following well-known organizations: Alexander Hamilton Institute, Burroughs Adding Machine Company, Dennison Manufacturing Company, Equitable Life Assurance Society of the U. S.; Goodyear Tire and Rubber Co., Metropolitan Life Insurance Company, National Cash Register Company, and Swift and Company. The third section consists of addresses and discussions on the subject delivered at the 1923 session of the Sales Executive Division. Because the material is based on successful methods in use by representative organizations it will be of great practical value to sales managers or others interested in the training of salesmen.

Unhampered by Facts. 658.808
Roger F. Davidson. *Advertising Fortnightly*, March 12, 1924, v. 2, pp. 16, 63-65. Experiences of a "research counselor" and the value of cost analysis and statistical facts to the manufacturer.

What Dealer Distribution Means. 658.83
F. L. Steinhoff. *Brick and Clay Record*, February 19, 1924, v. 64, pp. 252-255. Illus. Charts. Suggests to common brick manufacturers ways of increasing their sales by distributing to dealers.

Technical

Adjustments on Machine Tools. 621.88
F. Horner. *British Machine Tool Engineering*, January February 1924, v. 3,

pp. 10-16. Illus. Discusses machine fastenings, their special characteristics and value with an outline sketch for each.

Amerikanische Normen für Leistungsversuche an Locomotiven. 621.1313
Nordmann. *Zeitschrift des Vereines Deutscher Ingenieure,* February 23, 1924, v. 68, pp. 170-173. Discusses American locomotive performance and especially the "Test Code for Locomotives" issued by the American Society of Mechanical Engineers and compares these with the German practice.

The Automotive Industry and National Defense. 629.1
Brig. Gen. C. L. H. Ruggles. *Society of Automotive Engineers Journal,* March 1924, v. 14, pp. 319-322. How the third largest industry in the United States may in time of peace be a source of preparedness and ready for immediate service in case of war.

Building Electric Elevator Winding Machines. 621.867
H. P. Armsen. *Canadian Machinery,* March 20, 1924, v. 31, pp. 15-18. Machining operations employed in the production of electric geared traction elevator equipment in the Turnbull Elevated Company's plant, Toronto.

The Correct and Incorrect Use of Fuel Oil. 621.1845
H. A. Andersen. *Railway Mechanical Engineer,* March 1924, v. 98, pp. 169-174. Illus. Describes four types of burners and the problems connected with their installation and management.

The Design of Diagrams for Engineering Formulas and the Theory of Nomography. 510.8
By Laurence I. Hewes and Herbert L. Seward. 112 pp. (9 x 12). McGraw Hill Book Company. As its name indicates, this book presents the principles involved in designing graphic methods of solving engineering and other formulas. Only sufficient theory to form a basis for explaining fundamental operations has been included. In the main, the book is devoted to a practical presentation of the subject. Fifty-four illustrative examples have been worked out to a large scale, many occupying a full page. These diagrams are plainly and clearly drawn. Several of the more difficult examples have been developed in detail. Function scales, elementary diagrams and various phases of alignment diagram and development are amply covered. Third order determinants and the use of projective transformation are given. In appendices these subjects are explained for the benefit of those not familiar with them. The book is written for the use of the practical engineer as well as for the student of graphic methods of presentation. An idea of the field covered is given by the following selection of formulas for which charts are laid out: riveted joints, shafting diameters, girder stresses, pressure on cutting tools, strength of cylinders, time of turning metal in lathe, strength of gear teeth, length of belts; pressure of expanding steam, steam velocities, steam flow, thermodynamic equations, heat transfer, chimney calculations, alternating current voltage, areas of sections.

Efficiency Taught and Demonstrated. 621.101
Black Diamond, March 15, 1924, v. 72, pp. 300-301. Illus. A description of the steam power plant at the Michigan Agricultural College. This new plant embodies the ideas of the college engineering department which investigated all types, together with costs, maintenance and results achieved by each, before deciding on the type constructed.

Factory and Plant Maintenance. 621.1
Arnold A. Arnold. *Mechanical World,* February 22, 1924, v. 75, pp. 119-20. Considers some of the mechanical faults which may be found in steam engines, and the importance of detecting and remedying defects and providing suitable foundations for engines.

General Methods of Water Purification for Industrial Purposes. 621.18
B. Heastie. *The Engineer,* February 29, 1924, v. 137, pp. 225-226. Treatment of water for boiler-feed purposes. Discusses purification by distillation, by chemical means, and by physical means; zeolite softeners, elimination of iron, and extraction of oil.

How to Check up on Insulating Varnishes and Their Solvents. 667.7
H. L. Hazeltine. *Industrial Engineer,* March 1924, v. 82, pp. 123-127. Illus. Discusses classes of varnishes, life tests, long-oil and short-oil and how to select thinners.

Metallurgical Control in Automobile Foundry Practice. 621.72
A. Harley. *Foundry Trade Journal,* March 13, 1924, v. 29, pp. 207-210. Illus. Modern conditions and tendencies, organization of labor conditions and a study of materials and their use in automobile building.

New Use for Refuse Refractory Material. 666.76
S. F. Walton. *The Iron Age,* March 13, 1924, v. 113, pp. 786-88. A method of utilizing broken fire-brick from old furnace construction.

Oxy-Acetylene Machine Welding. 665.882
F. E. Rogers. *Acetylene Journal,* February 1924, v. 25, pp. 377-380. Illus. The application of automatic machines and single and multi-flame welding torches to production work.

Precision Grinding Operations. 621.92
F. B. Jacobs. *Abrasive Industry,* February 1924, v. 5, pp. 29-33. Illus. (To be continued). Describes grinding methods followed at the White Motor Co., Cleveland, the result of innumerable operation studies. Every job carries a bonus and the operators have an incentive to increase production.

Pressed-Metal Engineering. 671
Douglas P. Cook. *Mechanical Engineering,* March 1924, v. 46, pp. 123-128. Comments upon the present conditions and problems of the pressed-metal industry, the rapid growth of the industry, its relation to the automotive industry, and conditions which have handicapped it in expanding.

Principles of Interchangeable Manufacturing. 621.9(003)
J. Buckingham. *Canadian Machinery,* February 7, 1924, v. 31, pp. 31-34. Economies effected by machining the component parts of a given commodity within such limits that they may be assembled without fitting or further removal of material.

Some Limitations on Manufacturing to Close Limits. 621.7163
B. H. Blood. *Mechanical Engineering,* April 1924, v. 46, pp. 186-188, 205. In manufacturing mechanisms where close fitting is required, there are but few critical dimensions which need to be held to close limits. Gives some examples of extremely close measurements to show that unnecessarily close tolerances involve great expense, and should be avoided.

Standard Data Sheets for Machine Tool Builders. 621.9
A. L. Evans. *American Machinist,* March 13, 1924, v. 60, p. 381. A series of standard sheets have been designed to simplify the work of planning, routing, designing, equipping tools, making time studies, changing factory layout and similar tasks.

Die Technischen und Wirtschaftlichen Aussichten von Höchstdruckdampf. 621.18
F. Minzinger. *Zeitschrift des Vereines Deutscher Ingenieure,* February 16, 1924, v. 68, pp. 137-146. Diagrams. High pressure steam technique. Includes superheaters, economizers, high-pressure steam-boilers, feed-water and various steam-raising problems.

Water Purification for Industrial Purposes. 628.16
J. P. O'Callaghan. *Engineering* (London), February 29, 1924, v. 107, pp. 286-287. A careful outline of the major phases of water purification.

Transportation

American Railroads "The American Ways." 656.2
84 pp. Bank of the Manhattan Company. Illus. This booklet contains a historical outline of the origin and growth of American railroads.

Trucks, Truck Bodies, and Transportation. 656.124
M. W. Potts. *Industrial Management* (N. Y.), March 1924, v. 67, pp. 151-60. Illus. Extent to which loading and hauling costs can be decreased by the use of various kinds of material handling equipment. Gives possibilities of efficient cooperation between railroads and trucks by use of container cars for delivery of less than car-load volumes.

Why the light shines bright tonight along "Main Street"

THE light shines bright tonight on your town's Main Street largely because mechanical stokers in the power house are on the job.

The stokers were probably placed there during recent years—were placed there because the use of more electricity had called for more steam to turn generators, more heat to make steam—more heat than could be produced in old fashioned boiler furnaces fired by hand.

And the stokers were placed there by men whose business is selling power—and therefore making it at the lowest possible cost. They were placed there because these men knew that hand fired furnaces wasted their chief raw material—coal. The cost of these stokers had to be justified by operating economies—coal and labor saved!

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Greater steam demands can be met without adding to your present boiler equipment. Three boilers can be made to do the work of four through the higher combustion rate made possible by—

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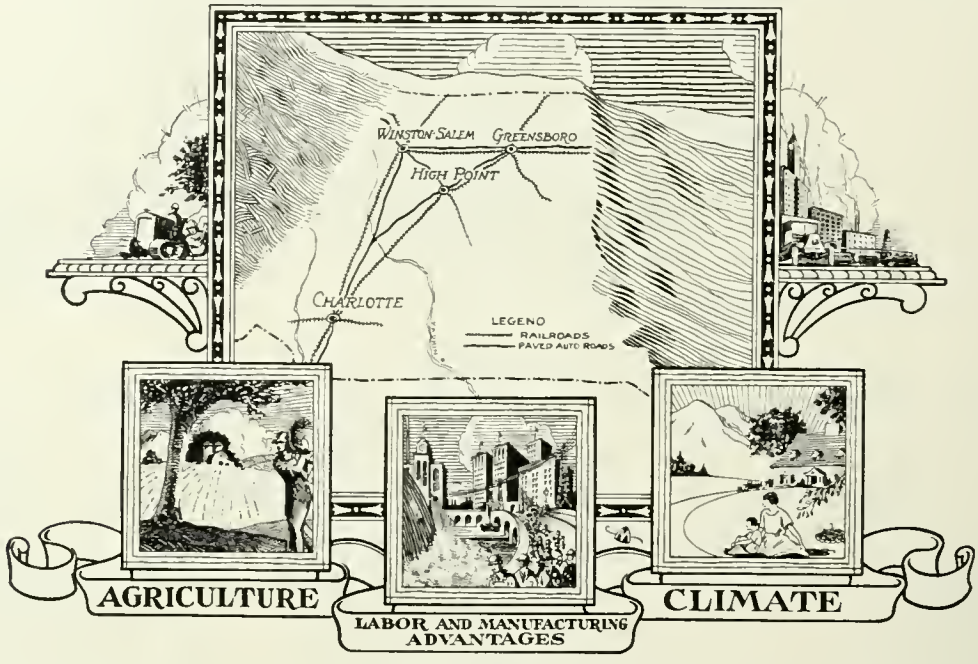

Cities of Leadership

WINSTON-SALEM—Originally settled, 1766, by a Moravian colony seeking ideal agricultural and climatic conditions. Elevation 893 feet. Annual mean temperature, 57.8. Estimated 1923 population 56,230. World's greatest tobacco manufacturing city. Pays more tobacco tax than any state. County's largest manufacturer of men's knit underwear. Smallest city tax rate in the state. Leads South in making of tires, wagons, woolen goods. Third city in the South in value of manufactured products. Pay-roll, $20,000,000.

HIGH POINT—Second Greatest U. S. Furniture market. Million-dollar Southern Furniture Exposition Building, six acres of floor space, largest of its kind. Value of annual products, $30,000,000. Has an industry to every 170 people, more than any other city of its size. Estimated population, 25,000. 80% own their own homes. Textile industry almost as great as furniture industry. 940 feet elevation. Mean annual temperature, 58.

GREENSBORO—World's greatest denim production. Largest exclusively canton flannel industry. Insurance center of the South—four life companies and four fire companies home offices. At axis of north, south, east and west railways, where National Highway crosses N. C. State east and west highway. Hence, center for distributing and business travel. Noteworthy business men's city government. Elevation, 843 feet. Annual mean temperature, 59. Estimated population, 48,000.

CHARLOTTE—Distributing center for both Carolinas. Four railroad lines, 100 trains daily. Center of the greatest hydro-electric power development in the country—the Southern Power Company. Center of Southern Textile Industry—737 mills within 100 miles, operating 10,000,000 spindles. Estimated population, 65,000. Elevation, 780 feet. Annual mean temperature, 60. Has 200 sales headquarters or branch houses for distributing goods.

All these four cities have unlimited power, ample native white labor, almost no foreign-born population; fine new modern hotels, country clubs, fine educational institutions, wonderful climate, permitting outdoor life the year around, close proximity to famous summer resorts and winter resorts.

AMAZING industrial development in the South has brought into that country within the past year scores of investigators and analysts, who find that the climax of this southern industrial success is found upon the Piedmont Plateau of North Carolina, where the three great factors in efficient manufacturing—power, labor and climate—approximate most nearly an ideal situation.

The Piedmont country, with an average elevation of 800 feet, midway between the Appalachian Mountains and the Atlantic Ocean, takes a southwesterly course from lower Virginia to north Georgia. Its main artery is the Southern Railway. At intervals it is deeply furrowed by the courses of those great rivers whose falls and rapids, harnessed by the Southern Power Company, furnish hydro-electric power without limit, its stations so interconnected that nothing short of a general cataclysm could interrupt their service.

This region is in the geographical center of Eastern United States, close to the centers of population, well served with railroads, near to the raw materials of farm, forest, mine and fishery. On its farms and in the hills of its uplands have been bred for centuries a native white stock, independent of thought and action, religious, of frugal habit and simple tastes. These people are now the workers in the southern mills. They are opposed to socialism, communism, syndicalism and all foreign propaganda. They turn a deaf ear to organizers and agitators.

Best of all is the Piedmont climate—equable, free from extremes, having neither the languor of far southern summers nor the rigor of northern winters—a healthful climate, permitting outdoor life the year around, bringing out the best there is in the worker. The famous winter and summer resorts are near at hand, the best of hunting and fishing within short drives.

All the statistics that a business man would require may be had by writing each of the cities listed below.

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GREENSBORO

NORTH CAROLINA

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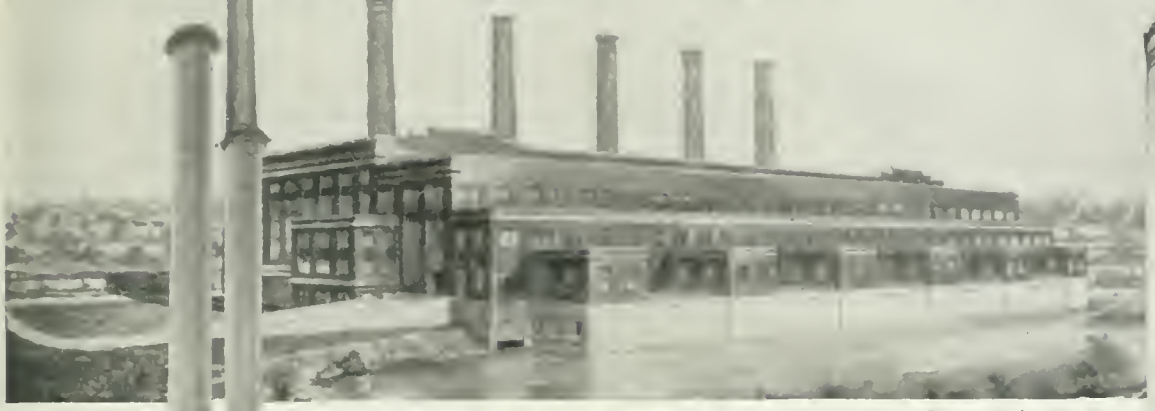
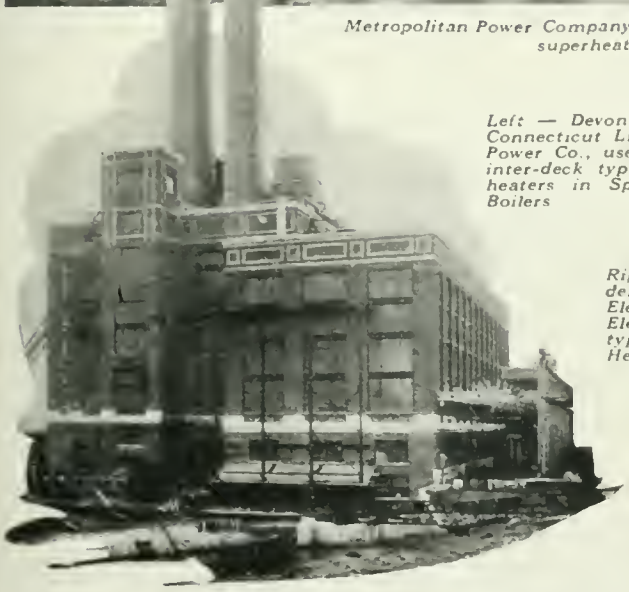
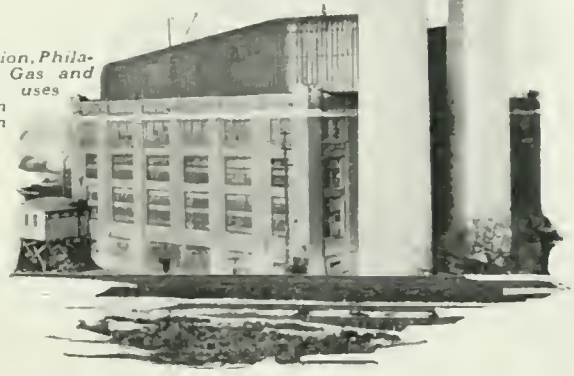


Metropolitan Power Company uses Elesco Outside Header Construction superheaters in Connelly Boilers.

Left — Devon Plant, Connecticut Light and Power Co., uses Elesco inter-deck type superheaters in Springfield Boilers



Right–Cromby Station, Philadelphia Suburban Gas and Electric Company uses Elesco Convection type superheaters in Heine Boilers.



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Volume II is primarily a study of accounting for corporations, although most of the material is equally applicable to other types of organization. Emphasis is laid upon the problem of valuation as found in the commercial balance sheet. Special points such as the voucher system, consolidations, branch house accounting, consolidated statements, surplus, reserves, depreciation, and the accounts and reports of receivers and trustees, are fully treated. *1918 (13th printing, 1923). 796 pages. Cloth. $4.00.*

Volume III applies to specific industries the principles laid down in the first two. It deals fully with accounting for various forms of organization as department stores, coal and metal mines, iron foundries, ranches, hotels, advertising agencies, municipalities, and savings banks. The author also describes C. P. A. office organization and accounting, accounting department organization, bank credit and foreign exchange accounting. *1921 (4th printing, 1923). 718 pages. Cloth. $5.00.*

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Published under the Auspices of The Associated Knit Underwear Manufacturers of America

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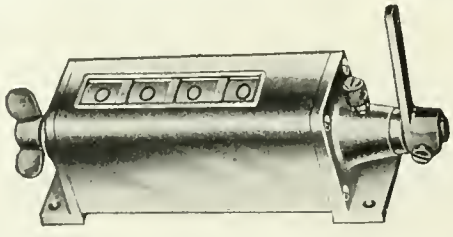

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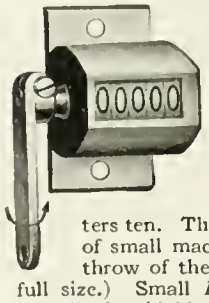

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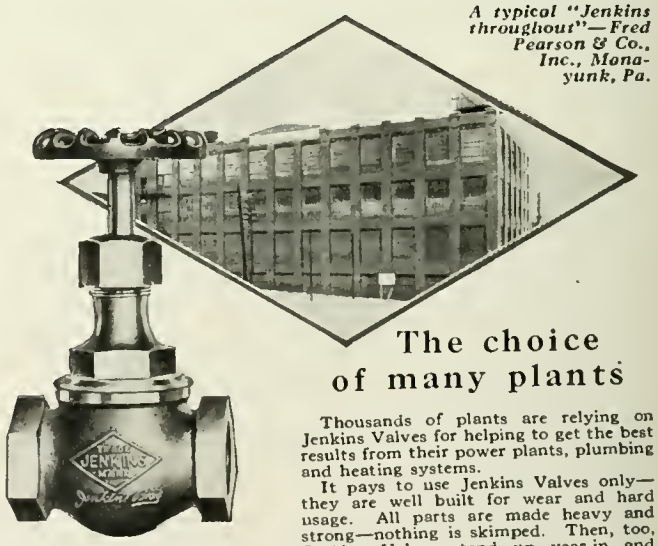

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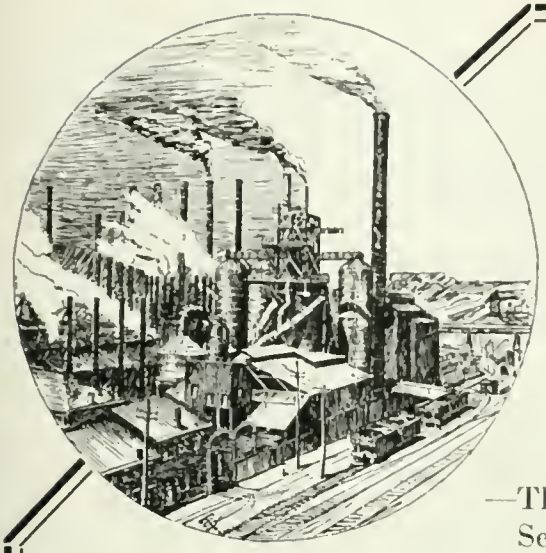

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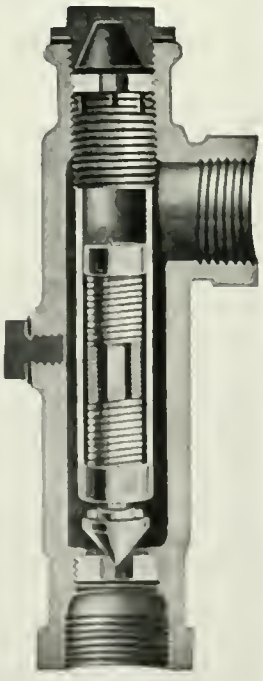

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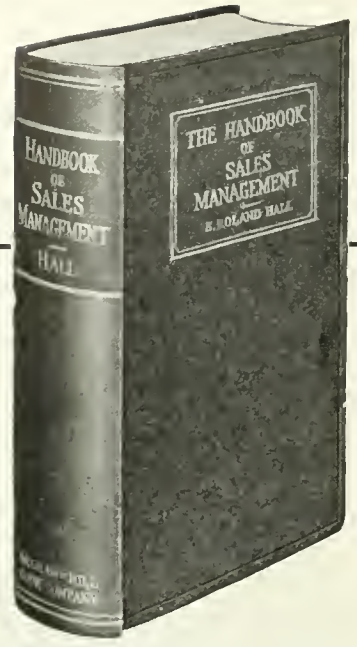

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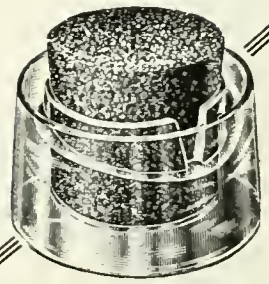

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THIS imposes a definite obligation upon A B P papers which can not be misunderstood. In this Standard, our publishers plainly acknowledge their responsibility to their subscribers, and pledge themselves to keep the trusteeship inviolate.

Do you not begin to see why business papers aspire to A B P membership; why membership carries the prestige that it does; and why A B P papers are getting preferred consideration from those who believe in high standards especially when coupled with practical achievement?

THE ASSOCIATED BUSINESS PAPERS, INC.

JESSE H. NEAL, *Executive Secretary*

HEADQUARTERS: 220 WEST 42nd STREET NEW YORK CITY

REDUCE YOUR PRODUCTION COST WITH

DEPENDABLE SERVICE

Is a built-in quality of O. S. Locomotive Cranes. We have pledged ourselves to build only the sort of Locomotive Cranes that will give the maximum in Dependable Service.

Portability and Flexibility are features of the O. S. Dependable Crawling Tread Crane. Ease of control and operation adapt them to all work where this type of equipment can be used.

Leading manufacturing companies in many industries are finding O. S. Dependable Locomotive Cranes major factors in reducing their production costs.

If you have a heavy material-handling problem it will pay you to let our engineers discuss it with you.

The many advantages of this crane are detailed in a bulletin which will be sent on request.

ORTON & STEINBRENNER CO.
608 SOUTH DEARBORN STREET
CHICAGO, ILLINOIS

A few of the 350 Hyatt equipped trailers, type A-310, built by the Mercury Manufacturing Company, Chicago, Ill., in operation at the freight house of the Louisville & Nashville Railway at Birmingham, Ala. Other large installations of these trailers are as follows:

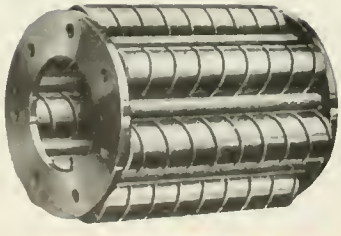
Pennsylvania Railway, Detroit, Mich.	150 trailers
Chicago, Burlington & Quincy Railroad, St. Joseph, Mo.	75 trailers
Chicago, Burlington & Quincy Railroad, Chicago, Ill.	200 trailers
Chesapeake & Ohio Railroad, Charleston, W. Va.	200 trailers
Baltimore & Ohio Railroad, Columbus, O.	150 trailers
Southern Pacific Railroad, San Francisco, Cal.	100 trailers

Hyatt Roller Bearings on Mercury Trailers

Realizing that easy turning wheels with bearing dependability and durability are the basis of satisfactory trailer performance, the Mercury Manufacturing Company equips its standard A-310 trailers with Hyatt bearings exclusively.

Whether these trailers are pushed by hand or hauled in trains, the Hyatt bearings enable them to carry heavier loads in less time.

More freight moved per truck, per man and per hour is the platform on which Hyatt bearing equipment bases its claim of superiority.



HYATT ROLLER BEARING COMPANY

NEWARK DETROIT CHICAGO SAN FRANCISCO

WORCESTER MILWAUKEE HUNTINGTON MINNEAPOLIS PHILADELPHIA CLEVELAND PITTSBURGH BUFFALO INDIANAPOLIS

MATERIAL HANDLING EQUIPMENT

COAL TIPPLE EQUIPPED WITH WELLER CONVEYING MACHINERY

SAVE TIME, MONEY AND WORRY

INSTALL WELLER MACHINERY. HANDLE THE RAW MATERIALS AND FINISHED PRODUCTS IN YOUR PLANT MECHANICALLY INSTEAD OF WITH HAND LABOR. WELLER EQUIPMENT PAYS LARGE DIVIDENDS.

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For Storing Coal or Conveying Coal and Ashes in the Boiler Room there is a Weller System

WELLER MADE CHICAGO

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BUCKET CONVEYORS
CHAIN CONVEYORS
SPIRAL CONVEYORS
ASH ELEVATORS
BUCKET ELEVATORS
PACKAGE ELEVATORS
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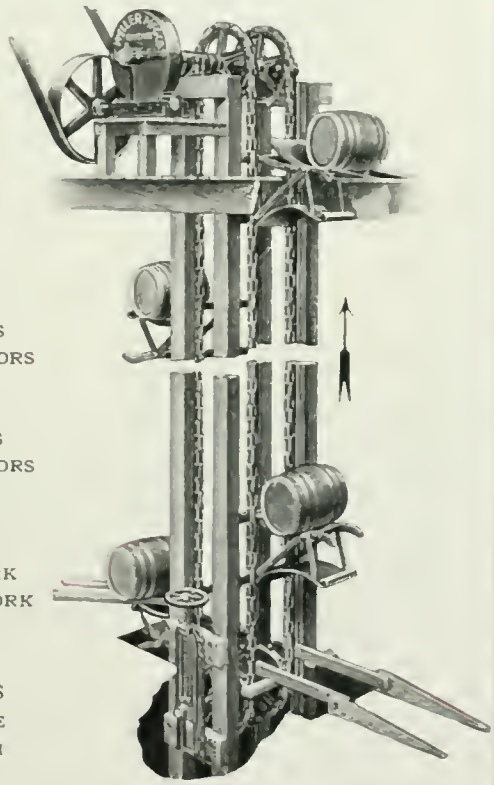
WEIGH LARRIES
POWER SHOVELS
CAR PULLERS
HEAVY SHEET METAL WORK
STRUCTURAL STEEL WORK

WELLER ENGINEERS
ARE AT YOUR SERVICE
SUBMIT YOUR PROBLEM



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For Elevating Barrels and Packages from Floor to Floor and from Basement to Loading Platform.

WELLER MFG. CO.

1820-1856 N. Kostner Ave., CHICAGO, ILL.

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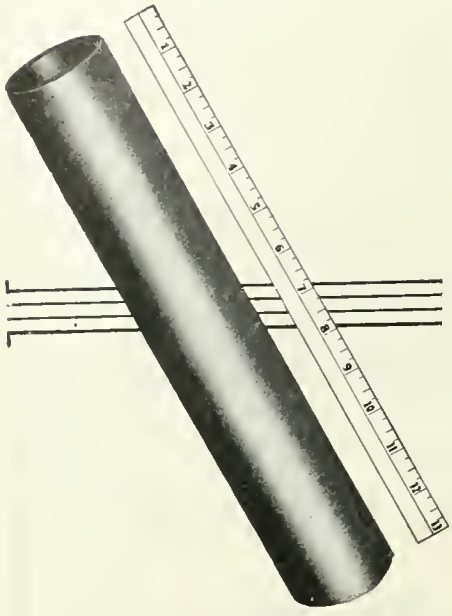

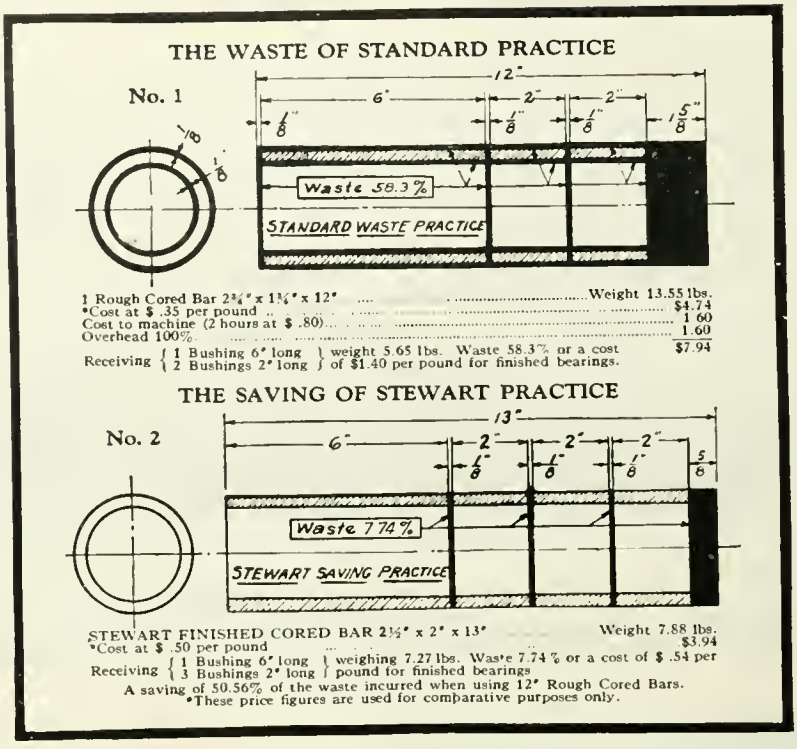
THE WASTE OF STANDARD PRACTICE
No. 1
12"
6"
2"
2"
Waste 58.3%
STANDARD WASTE PRACTICE
1 Rough Cored Bar 2¾" x 1¾" x 12" ..... Weight 13.55 lbs.
*Cost at $ .35 per pound $4.74
Cost to machine (2 hours at $ .80) 1.60
Overhead 100% 1.60
Receiving { 1 Bushing 6" long } weight 5.65 lbs. Waste 58.3% or a cost of $1.40 per pound for finished bearings. } $7.94
THE SAVING OF STEWART PRACTICE
No. 2
13"
6"
2"
2"
2"
Waste 7.74%
STEWART SAVING PRACTICE
STEWART FINISHED CORED BAR 2½" x 2" x 13" Weight 7.88 lbs.
*Cost at $ .50 per pound $3.94
Receiving { 1 Bushing 6" long } weighing 7.27 lbs. Waste 7.74% or a cost of $ .54 per pound for finished bearings
A saving of 50.56% of the waste incurred when using 12" Rough Cored Bars.
*These price figures are used for comparative purposes only.

13-Inch Bars!

Save 50% on Bars and Bushings

What Stewart Brons Metal Is

The perfect copper-lead mixture that will not segregate. Under successive remeltings, the union of metals is even closer. Sweats a little lead of 600° F., lubricating itself. Will not score shafts up to 1000° F. Melts at 1700° F. Coefficient of friction very low. Made in 258 stock sizes, finished all over, in four degrees of Brinell hardness for all bearing conditions—our standard Grade "D" Metal is perfect for the average bearing requirement. All solid and cored bars 13-inch lengths!

That chart above tells the whole story! Bearings are generally made in 2-inch or 3-inch lengths or multiples of those numbers, aren't they? And in cutting off the bearings and finishing the ends, you lose some of the metal, don't you?

As a result, you only get approximately 10 inches of bearings out of a 12-inch bar. You can get 12 full inches of bearings out of a Stewart 13-inch bar.

Is it worth your while? Just study that chart. Stewart bars are finished all over. That not only saves you machining costs and metal loss but insures you absolute uniformity in your metal. Stewart Brons is the greatest copper-lead mixture ever developed. When we first brought it out, it was bought because of its saving in the 13-inch size. *Now* it is being bought as well for its service as the *perfect bearing metal.*

JOBBERS! We have a great opportunity in a few remaining territories. We're showing big sales increases. Write for particulars to

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4503-85 Fullerton Avenue Chicago, Illinois

Or communicate direct with our nearest factory representative

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327 First Avenue
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E. P. GRISMER
1982 E. 66th Street
Cleveland, Ohio

Stewart Brons Bearing Metal

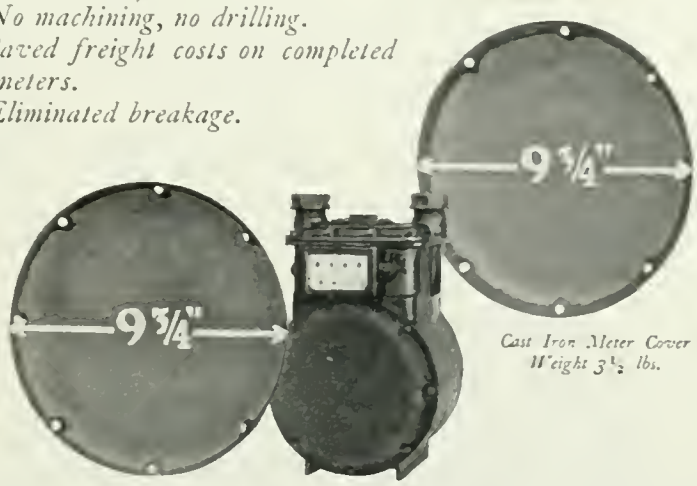
The Perfect Metal for Bearings

On the Street Corner

By chance, one of our consulting engineers saw a gas meter with a cast iron cover, lying at the curbstone, pending installation in a new dwelling. He noted the name of the manufacturer of the meter and later suggested to the maker the possibilities of a pressed steel part to replace the cast cover. Pressed Steel gave the meter manufacturer some unexpected advantages over the old cast covers:

1. *Cut cost 10%.*
2. *No machining, no drilling.*
3. *Saved freight costs on completed meters.*
4. *Eliminated breakage.*

"Press it from steel instead"



Pressed Steel Meter Cover Weight 2¾ lbs.

Cast Iron Meter Cover Weight 3½ lbs.

Doubtless your product is never going to stand on a street corner, but there is a way, without waiting for us to meet you accidentally, of finding out how pressed steel parts may cut costs or give added sales advantages.

The Way We Go About It

You're interested. You tell us so, perhaps sending a sample part or blue-print.

When convenient for you one of our consulting engineers goes to your plant for consultation. He knows pressed steel redevelopment from A to Z. He belongs to our highly trained staff of redevelopment pioneers. He works with facts. He has helped put through scores of successful redevelopment jobs on a great variety of problems. He gives you the benefit of knowledge gained through years of specialization in redesign.

Behind him is a great modern plant located in the heart of the steel district with complete facilities for producing the most intricate pressed steel parts—large or small.

He studies your problem in this way:

1. *Can the cast parts used in your product be pressed from steel instead?*
2. *If not, can they be redesigned to permit pressing from steel instead?*
3. *Would pressing from steel instead create any advantages in the product and secure savings in production and shipping?*

If pressed steel will *not* be useful he frankly tells you so and you are in no way obligated.

If he finds pressing from steel instead *will* be an advantage to you our engineering department immediately undertakes the development of the replacement.

Drawings of proposed designs are submitted without obligating you.

On your approval, our force of diemakers and press men start the actual work of pressing it from steel instead for you.

This unusual service is at your disposal NOW.

THE YOUNGSTOWN PRESSED STEEL COMPANY

Pioneers in Pressed Steel Redevelopment

Warren, Ohio

Tear out this page and hand it to your designing engineer.

"Saved—Many Thousands of Dollars in Loading and Unloading Expense"

For over 40 years industrial concerns confronted with material handling problems have found the solution to these problems in Brownhoist equipment. The labor savings that follow their installation, their economy of operation and maintenance, and their wide adaptability, make them an exceedingly profitable investment.

The experience of the John Deere Harvester works, East Moline, Illinois, offers a good example of Brownhoist trouble-free operation, combined with large direct savings. They say:

"We purchased a Brownhoist Locomotive Crane in the spring of 1920. This is a No. 4 Crane with a 50 ft. boom, capacity 15 tons at 16 ft. radius and 3 tons at 50 ft. radius. This machine has been in continuous service since that time and we found the maintenance cost to be extremely low. It has given us no trouble of any kind and has saved us many thousands of dollars in unloading and loading expense."

If you have a material handling problem of any sort, Brownhoist engineers will gladly help you. The advice is yours for the asking

The Brown Hoisting Machinery Co., *Cleveland, Ohio*

Brownhoist Products: Heavy Dock Machinery, Locomotive Cranes, Bunkers, Conveyors, Bridge Cranes, Buckets, Etc
Branch Offices: New York, Chicago, Pittsburgh, San Fraocisco, New Orleans, London, Eng.

BROWNHOIST

MATERIAL HANDLING EQUIPMENT

HOFFMANN PRECISION ROLLER BEARINGS

For Heavy Loads and Hard Service

Heavy-duty units manufactured to unequaled standards of precision; affording the maximum of serviceability under conditions involving heavy loads, temporary overloads, shock, jar and vibration; offering to manufacturers and users of high-duty, heavy-duty machinery new opportunities for power saving, reduced up-keep costs, and better service.

Our engineers will welcome an opportunity to work with yours in applying these high-duty, high-precision bearings to your machines, with a view to securing maximum anti-friction efficiency, minimum maintenance costs, and continuity of service.

THE NORMA COMPANY OF AMERICA
Anable Avenue
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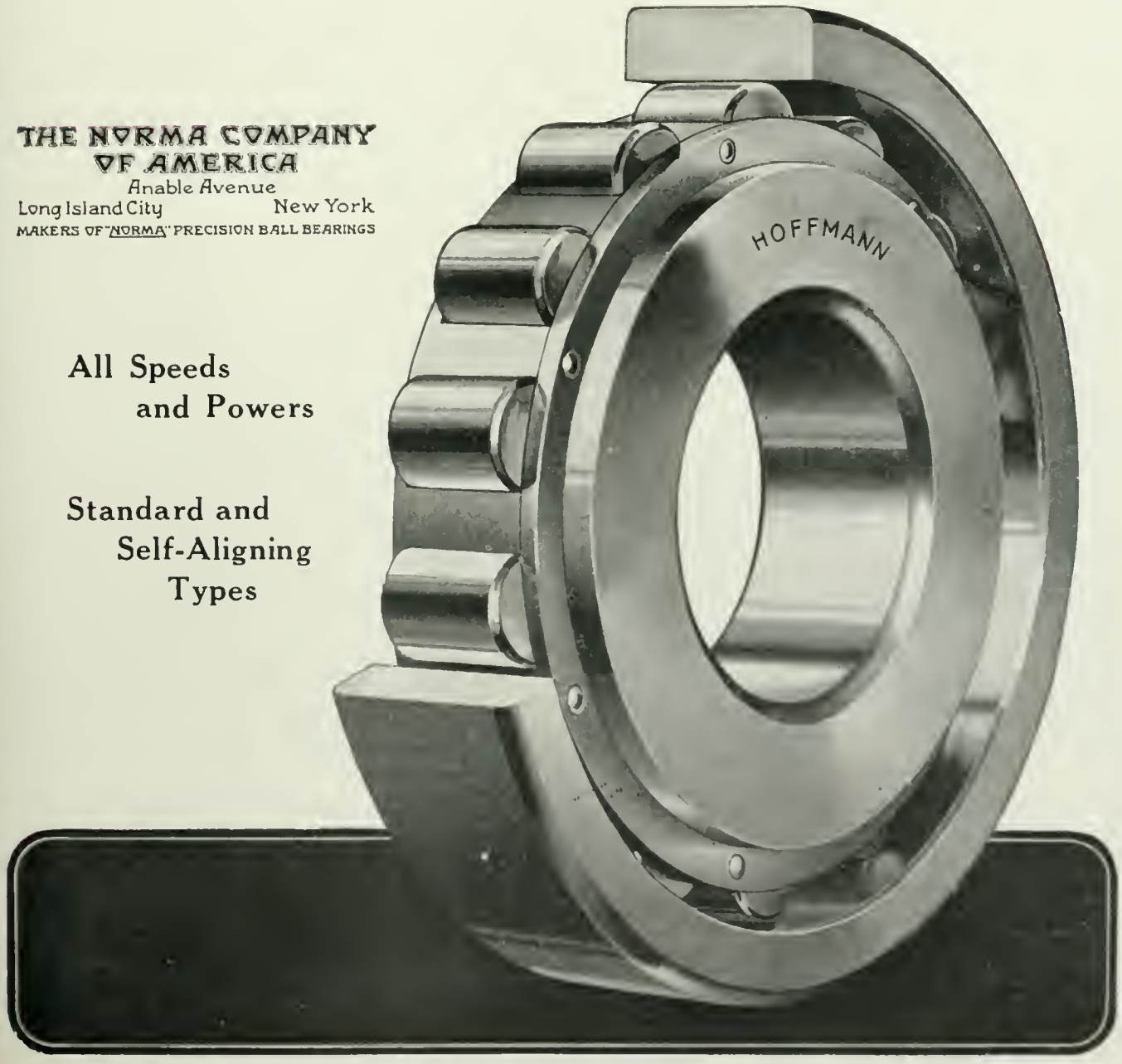
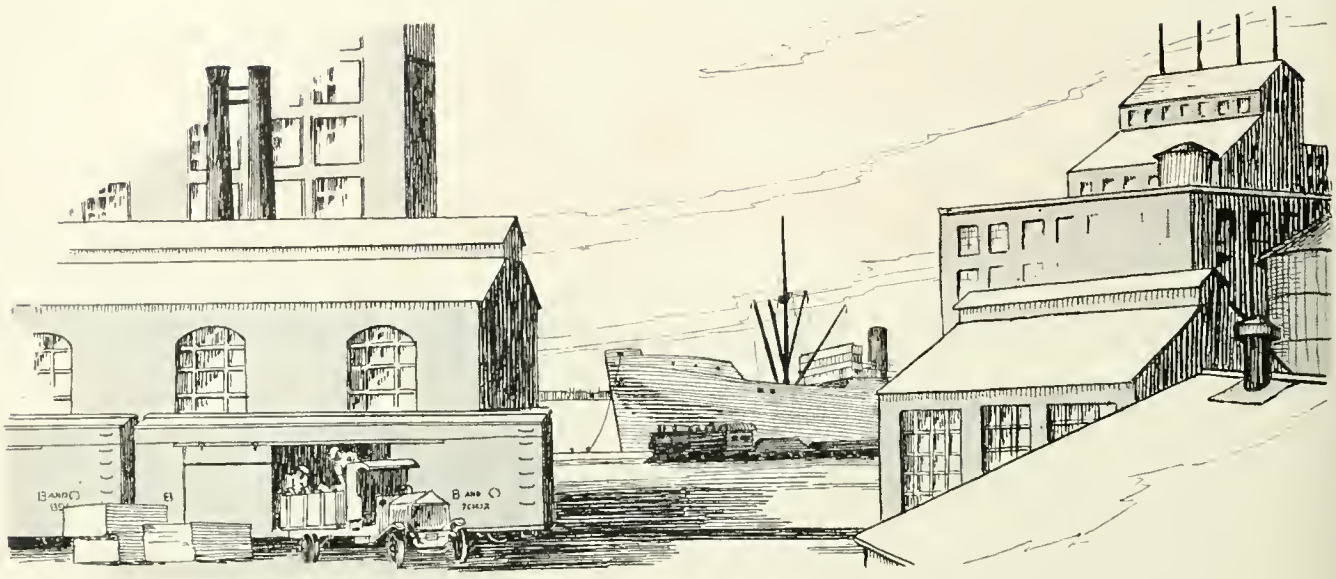
MAKERS OF "NORMA" PRECISION BALL BEARINGS

All Speeds and Powers

Standard and Self-Aligning Types





A Distributing and Manufacturing Center of Nation-Wide Importance

A list of the manufacturers who have factories or warehouses at Port Newark, or who center their eastern distributing activities at Port Newark, would include a score of names familiar to the business world from one end of the United States to the other.

These manufacturers have demonstrated the advantages to be derived from location at this remarkable development. They enjoy rail, water and highway shipping facilities not to be equalled elsewhere along the Atlantic Seaboard. They are in the midst of a buying area of forty million inhabitants, with their richest markets most quickly and economically accessible. They are receiving all the advantages of location *within the limits of New York Harbor* at a fraction of the cost for factory sites and rentals that they would pay elsewhere in the metropolitan zone.

A complete description of Port Newark and its surrounding territory, as well as a list of the industries already located in this area, is contained in a comprehensive free book which will be sent to you upon request. Write for your copy today.

Many of the most important cities on this map are within overnight trucking distance of Port Newark.

THOS. L. RAYMOND, Director

Department of Public Improvements **Newark, N. J.**

PORT NEWARK

Only 12 Minutes Shut-Down Per Year

If any production unit of your plant were to be shut down for only 12 minutes a year you would consider it an excellent record of operation.

If you started each year with the definite knowledge that only twelve minutes of operating time of any unit would be lost for lack of driving power—the very basis of production—would it not add to your confidence and satisfaction?

One of the world's largest manufacturers of carburetors—universally known—with plants equipped with individual and small group motor drive—has averaged only twelve minutes shut-down per motor per year. A large proportion of these motors are in use on their extensive conveyor system.

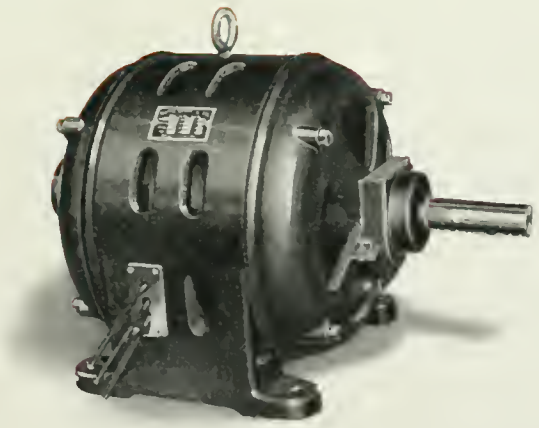
We are naturally proud to say that they are completely equipped with

ROTHMOTORS

We have had the pleasure of co-operating with this concern —in the equipping of its plants with motor drive — since its origin some years back.

May we tell you of other industrials and manufacturers who are using Rothmotors? May we help you in your power problems with our 30 years of specialized motor engineering experience?

Our bulletins are available to you on request.



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Men and women with sales, technical or executive ability, capable of earning $2,000.00 to $50,000.00 desiring such positions should write us. Not a school nor Employment Bureau, but a safe, confidential and logical way to obtain the connection you want. The Murray E. Hill Company, 301 Chamber of Commerce, Nashville, Tenn.

Have Your Copies Bound

BOUND volumes of MANAGEMENT AND ADMINISTRATION make permanently available for convenient reference a great mass of useful information not elsewhere obtainable. Hundreds of our subscribers have their copies bound at the completion of each volume.

For $2.00 you can have the six issues of Volume VI (July to December, 1923) bound in the durable Ronald blue cloth binding, with gold stamped title. Send us your copies (insured parcel post is safest) and we will bind and return them, delivery prepaid.

PLEASE note that we cannot undertake to supply missing issues as our stock of several numbers is exhausted.

The Ronald Press Company

Publishers

20 Vesey St. New York, N. Y.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of MANAGEMENT AND ADMINISTRATION—published monthly at Camden, N. J. for April 1, 1924.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared William J. Grange, who, having been duly sworn according to law, deposes and says that he is the secretary of the Ronald Press Company, publishers of MANAGEMENT AND ADMINISTRATION—and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:
Publisher—The Ronald Press Company, 20 Vesey Street, New York City.
Editors—Leon P. Alford, Hugh R. Conyngton, 20 Vesey Street, New York City.
Managing Editor—None.
Business Managers—None.

2. That the owner is:
The Management and Administration Corporation, 20 Vesey Street, New York City, in which the following own 1 per cent or more of stock: The Ronald Press Company, 20 Vesey Street, New York City; and Leon P. Alford, 20 Vesey Street, New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

THE RONALD PRESS COMPANY
(Signed) WILLIAM J. GRANGE, *Secretary.*

Sworn to and subscribed before me this 31st day of March, 1924.

(Signed) EUGENE J. CLEARY
(Seal) (My commission expires March 30, 1925.)

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B

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Bearing Metal
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C

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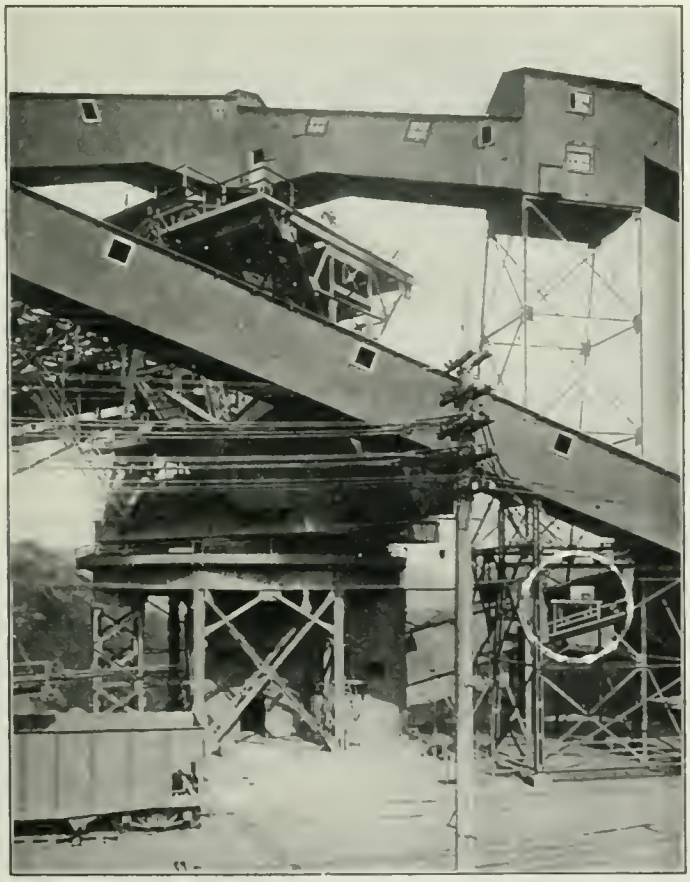

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Lane, H. M.
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F

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G

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Gas and Gasoline Engines
General Electric Co.

Gaskets
Sarco Co., The

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General Electric Co.

Gears, Speed Reduction
Westinghouse Electric & Mfg. Company

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Gratings, Steel
Irving Iron Works

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H

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Industrial Works

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General Electric Co.

Hoists, Manual, Electric
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I

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Insulation, Electric
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International Ticketograph
Tabulating Machine Co., The

Inventory Control Service
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L

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O

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R

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American Institute of Finance

Steam Traps
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T

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Traps, Steam
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Truck Platforms
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Turbines, Steam
General Electric Company
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V

Valves
Jenkins Bros.

Valve Fittings
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Valve Discs
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Valves, Radiator
Sarco Co., The

Voltmeters
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W

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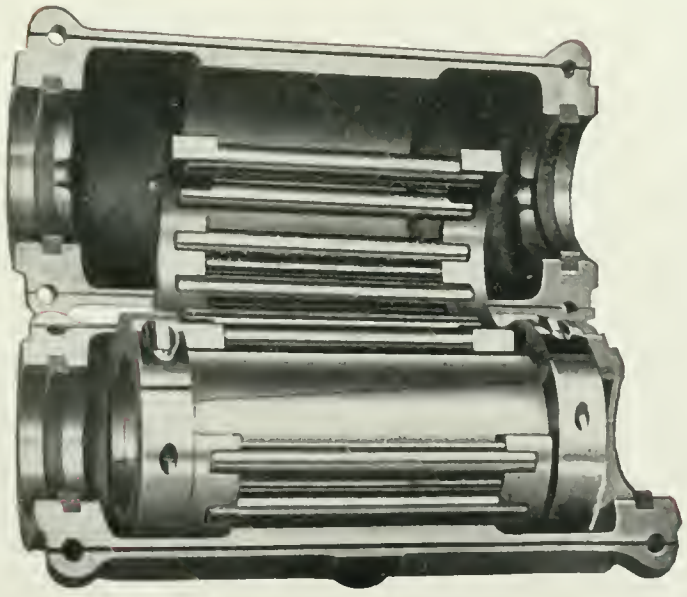

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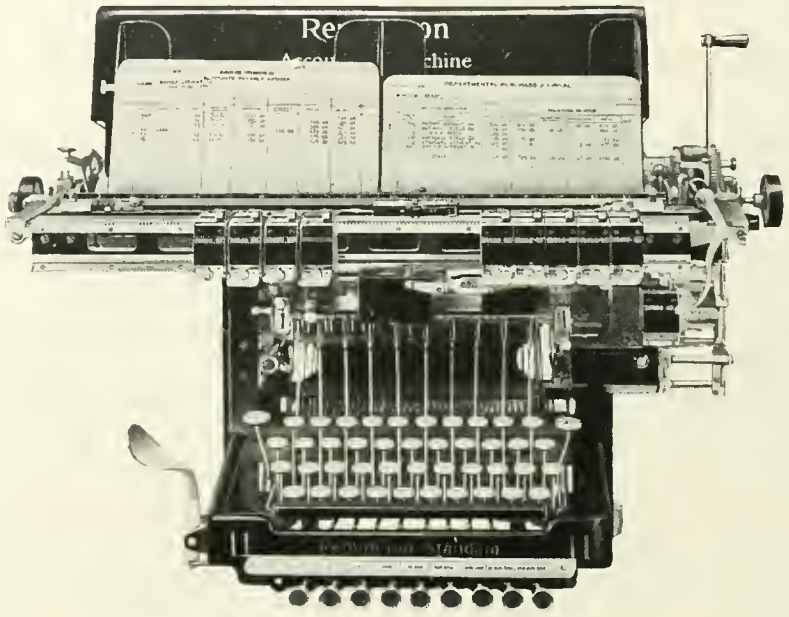

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MANAGEMENT AND ADMINISTRATION

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George E. Hagemann K. W. Stillman

Vol. VII

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Cover Illustration of 40-ton Gantry Crane Installed in the Freight Yards of the New York Central Railroad, New York City. Courtesy of Niles-Bement-Pond Company

MANAGEMENT AND ADMINISTRATION is published monthly by the Ronald Press Company; Philip J. Warner, President and Treasurer; William J. Grange, Secretary.

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Printing of this issue, 11,000 copies

Authors and Articles in this Issue

THE specific benefits produced by thorough, practical, well-balanced management methods are described by **Murray M. Baker**, Vice-President and Manager of the Holt Manufacturing Company, in an article on the "Results of Scientific Management from the Viewpoint of Corporate Control". The effect of applying sound methods has been marked, not only on production and operating departments, but also upon sales, financial, and executive activities.

"Building Tractors Under Scientific Management," begins a series of articles by **George D. Babcock**, Manufacturing Executive of the Holt Manufacturing Company. In these articles are described the methods which have established such complete control over production that for over 600 consecutive working days output was high, yet neither above nor below the schedule planned in advance.

The series on "Capital Requirements and Control," by **J. H. Bliss**, Comptroller of Libby, McNeill & Libby, is concluded in this issue by the section on "The Protection of Working Capital". The subject of surplus is treated from the standpoint of building up a business to a strong financial position. Payment of too large dividends is avoided by making reservations from profits or free surplus.

Park Mathewson, Vice-President of the Bankers Development Corporation, contributes "The Mechanics of Profit-Making". In this article are presented problems which face the official in charge of a company's finances, who is usually the controller, when either expansion or curtailment of business is necessary.

The second article of the series on "The Southward Trend of Manufacturing," by **Ralph G. Macy**, deals with "The Power Supply of Southern Industry". Low-cost power is possible because of the hydroelectric development carried out by the Southern Power Company in the Piedmont section of the Carolinas, making individual power plants unnecessary. Mr. Macy is a consulting mechanical and electrical engineer.

"Organizing to Prevent Materials Waste," is the subject of an article by **C. B. Auel**, Director of Personnel Relations, Westinghouse Electric and Manufacturing Company. Both prevention and salvage methods are covered. In the present article the organization plan of waste prevention work is outlined. Subsequent articles will deal with salvaging of materials.

In an article on "Building a Successful Sales Manual," by **B. F. Juraschek**, Sales Adviser, a handbook prepared for the use of salesmen in a well-known manufacturing firm is outlined, chapter by chapter. The company's history, products, policies, and methods are included in this book, together with detailed instructions on how to sell.

Methods of the General Motors Corporation are explained in a series of articles of which the sixth is by **E. Karl Wennerlund**, Head of the Department of Factory Organization. In "Quantity Control of Inventories," the author contrasts the two outstanding systems of regulating quantities of materials and stores carried in stock, namely, financial control from the standpoint of money tied up, and physical control based on manufacturing needs.

"Distribution of Overhead to Jobs," is the title of the fifth article in a series by **Geoffrey C. Brown**, Chief Engineer of Jacques Kahn, Inc., on "Profitable Methods for the Small Factory". The principal systems in common use are discussed from the angle of the small plant. Selecting the machine-hour-rate plan as the most useful basis, the author explains how it works in his own organization.

G. W. Greenwood, Secretary and Treasurer of the Warren Lumber and Supply Company, under "New Forms of Depreciation Schedules," describes several methods of handling the increasingly important problem of depreciation. The systems outlined are: straight line, sinking fund, reducing balance, weighted year, and adapted sinking fund.

Additional summaries of experience data are added in this issue to the compilation presented last month on "Materials Handling Methods That Have Added to Industrial Profits," by **George E. Hagemann**, Associate Editor of MANAGEMENT AND ADMINISTRATION.

In Management Data Summary Sheet No. 27, on "Standard Forms for Office and Shop Use," is given a condensed statement of the factors involved in selecting paper for business purposes. Tables of original sheet sizes, and the dimensions of forms which will cut with minimum waste, are included. This information covers the latest recommendations of the Committee on Simplification of Paper Sizes, to go into effect on trial, July 1, 1924.

Robert F. Miller, Industrial Engineer with The Pfaudler Company, in "A Comparison of Premium Wage Plans," contrasts job costs, amounts of wages and relative advantages under the 100 per cent Premium, Emerson, Bedeaux, Rowan, Halsey, Barth, and Gantt systems of wage payment.

The advantages of graphic representation as applied to reports are presented in an article by **H. N. Stronck**, Industrial Engineer, with Arthur Andersen and Company, in an article on "Charts for Report Purposes". The making and using of line charts for sales and financial purposes, and the application of bar and geographical charts are among the subjects covered.

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THE PUBLISHERS' PAGE

A Year's Record

NO magazine has ever before brought together so many distinguished contributors on management topics as those who have written for MANAGEMENT AND ADMINISTRATION during the past year. The list of 81 authors includes some of the most successful executives of the country, such as Secretary Mellon of the Treasury; Howard Coonley, President, Walworth Manufacturing Company; Alvan T. Simonds, President, Simonds Saw & Steel Company. The accompanying summary gives an idea of the high standing and authority of the men who have contributed to the 12 issues under review.

CLASSIFICATION OF CONTRIBUTORS TO MANAGEMENT AND ADMINISTRATION
JULY 1923—JUNE 1924

CONTRIBUTORS	No.	PER CENT OF TOTAL
Presidents	10	
Vice-Presidents	8	
Treasurers	1	
Controllers	5	
General Managers	1	
Total	25	31
Chief Manufacturing Executives	3	
Sales Managers	2	
Superintendents	2	
Advertising Managers	2	
Misc. Department Heads	5	
Total	14	17
Production Engineers	4	
Mechanical Engineers	6	
Industrial Engineers	10	
Total	20	25
Government Officials	3	
Educators	5	
Miscellaneous	14	
Total	22	27
Grand Total	81	100

To our subscribers have been presented 1051 text pages, containing approximately 1,150,000 words, equivalent to 12 standard books of 300 pages each. Eight hundred and thirty illustrations, reproductions of photographs and drawings, enlivened these pages.

Two new monthly departments were added during the year to increase the magazine's usefulness. "Current Information Index" gives, monthly, some 200 descriptive items classifying current management information. Items are selected from more than 150 American and foreign periodicals and from the publications of over 50 societies and book publishers. An "at-cost" photostat service increases the usefulness of this department by supplying reproductions of any article to which the subscriber lacks access.

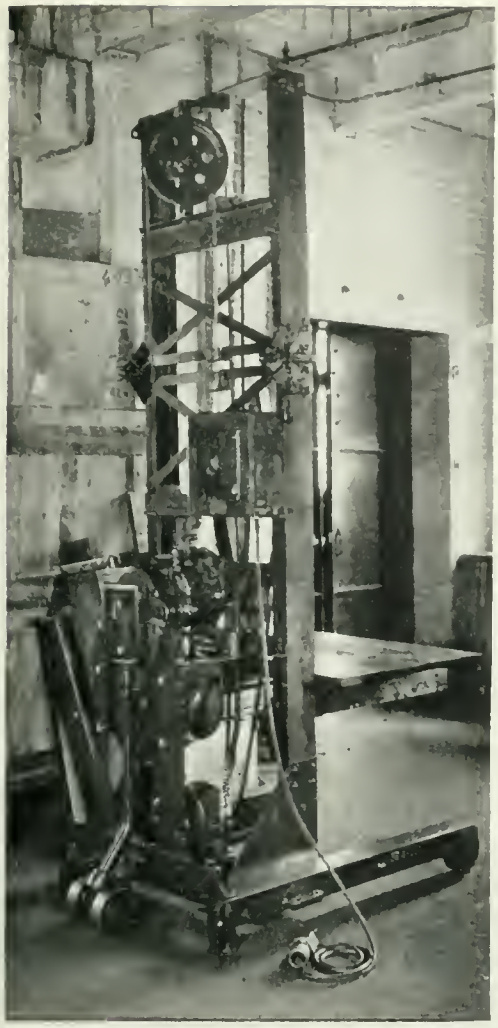
"News of Equipment," the other feature, gives the essential facts in regard to items of equipment recently placed on the market which may aid managers in more profitable operation. A unique feature of this department is emphasis on the economic advantages.

The record shows that **191 articles were published in all.** The sole basis for selection of each article was—Does it provide information which will aid our subscribers in their work? These articles cover the whole field of management — managerial control and direction of all production, financial, and marketing operations of industrial companies and the interrelated activities of those responsible for profitable management.

Several of the topics could not be given comprehensive treatment in one issue, resulting in 11 groups of articles, ranging from Dean Kimball's series which began in July 1923, to Colonel Babcock's, which begins in this issue. Three topics—General Motors' management methods by officers of that company, Ralph G. Macy's papers on the Piedmont section, and Colonel Babcock's articles on his work at the Holt plant—carry over into the next volume.

Another source of gratification is the **just recognition** being accorded to the magazine **by representative advertisers.**

As publishers, we are proud of the achievement of our editors, made possible by the support and encouragement of our subscribers. It is our aim to produce, with each issue, an even stronger and more useful publication.



Hyatt equipped Barrett-Cravens portable elevator.

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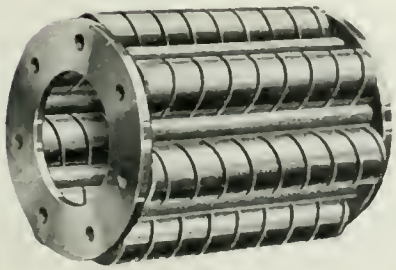

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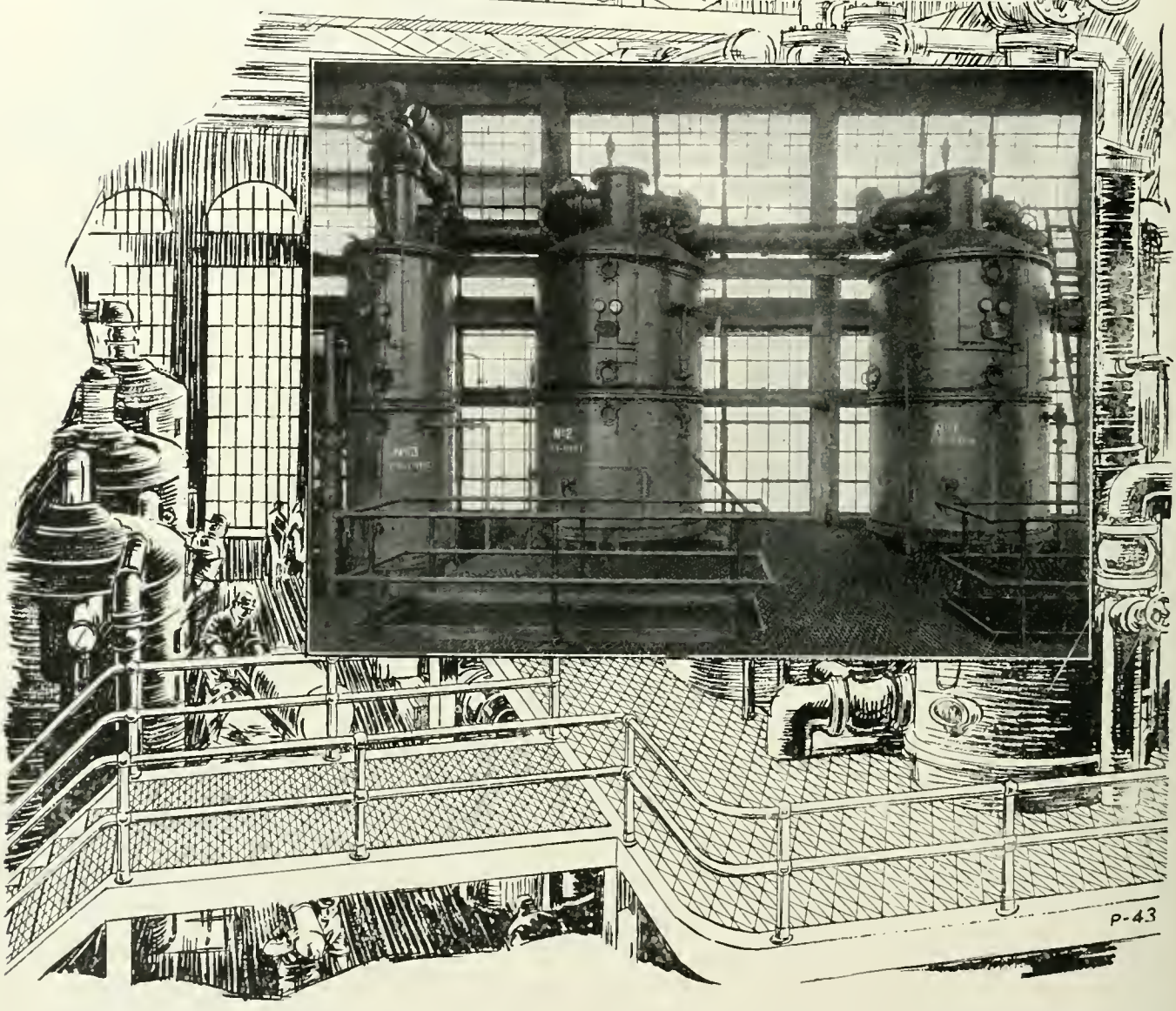

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PREPARED BY LEWIS H. HANEY

Director, New York University Bureau of Business Research [1]

Barometer of Industry and Trade

Recession Continues: No Indications of a Turn

No turn for the better has yet appeared in the conditions and prospects of business. The main forecasting line continued its downward course in April. The most that can be said is that a process of readjustment in prices and production has begun and that the downward trend of the P/V line, Fig. 1, has become less sharp.

The end of the existing recession in business, however, is not yet in sight. The peak in 1923 was built on great activity in the production of buildings and automobiles and this basis is now rapidly weakening. There is a fairly large volume of building in process, but the amount of contemplated new construction has fallen under the contracts actually awarded, and evidence of a general decline appears in the best indexes on building activity. The production of automobiles in April was 12 per cent less than that in both March 1924, and April 1923. The greater weakness in these two great industries means a reduced demand for many products, such as steel, copper, lead, zinc, lumber, cotton, leather, and rubber.

Further declines in the general price level are probable, and a continued decrease in the total volume of production is certain. Attention is called to the downturn in the index of bank debits. The adjusted index of checks drawn was 126 for April 1923; 128.7 for March 1924; and 123.4 for April.

The great change, therefore, during April, was probably a sharp decline in the output of many basic commodities, a decline which was especially notable in the case of iron and steel. Railway tonnage, which is an index of total production, declined 7.4 per cent, allowing for the usual seasonal variation.

At the same time the general price level declined, although less rapidly than in March. In fact, there are signs that, as a result of decreased production, the price level may soon show greater firmness. It is significant that coal and textiles showed slight increases in price during April, for those groups were the ones which led the sharp decline that has been going on. (The greatest decline during April came in the metal group).

[1] Assisted by Horace J. Barney, Harry Comer, and Stephen DuBrul of the Bureau's Staff.

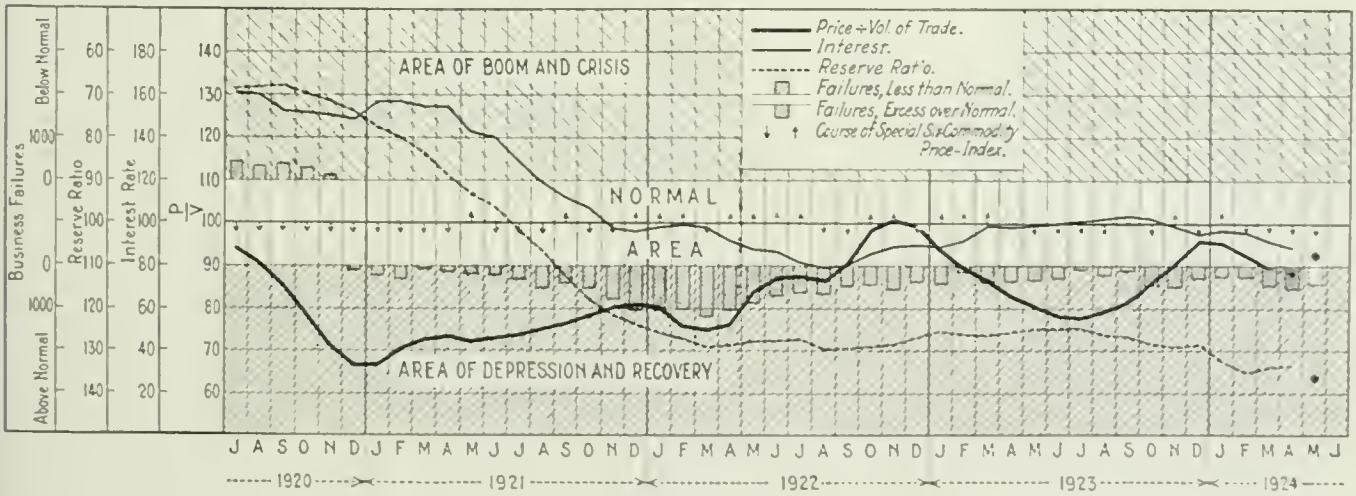

Business Failures
Below Normal
Above Normal
Reserve Ratio
Interest Rate
P/V
AREA OF BOOM AND CRISIS
NORMAL AREA
AREA OF DEPRESSION AND RECOVERY
Price÷Vol of Trade.
Interest.
Reserve Rat'o.
Failures, Less than Normal.
Failures, Excess over Normal.
Course of Special 5+Commodity Price-Index.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1920
1921
1922
1923
1924

FIG. 1 THE BAROMETER OF INDUSTRY AND TRADE

The P/V line (drawn heavy) is the business forecast line. It shows the trend of commodity demand, and is the ratio between Bradstreet's index of wholesale prices and the physical volume of trade (carloadings times tons per car), based on 1912 as the normal year. It is plotted as a three months' moving average, centered successively on the middle months, except that the final dotted portion of the line runs to the actual figure for the last month. A rise in the curve indicates increasing demand, and vice versa. The interest rate curve has been corrected for seasonal variation, and index number 100 equals 5 per cent. The federal reserve ratio of cash reserves to note and deposit liabilities is inverted to harmonize its indications with the rest of the curves, and is corrected for seasonal variation. Business failure bars are based on Dun's reports, and normal is taken as the trend for 40 years. The six-commodity price index is based on special investigation by the N. Y. U. Bureau. May 1924 data shown are probable trends. Areas in which curves lie indicate that business is good, normal, or poor.

Money continues easy, with a declining rate on commercial paper. The idea that easy money makes business good has been discredited. The point now is that money is easy because there is little demand for it.

The reason for this situation is that profits are narrowing. The big problem in the business world now lies in the narrowing spread between commodity prices and wages. As long as prices are falling while wages are maintained, there is but poor chance for good profits and the demand for capital will be weak.

An important sign of the times is the decline in employment. This decline immediately reflects the recession in production, and ultimately means a tendency toward reduced purchasing power among consumers. In New York the employment of factory labor, after allowing for seasonal variation, declined 2.2 per cent in April. In Pennsylvania and New Jersey there was a general decrease in employment which was most notable in the clothing and textile trades. Considerable decreases were also shown in blast furnaces, foundries, machine shops, tanning, shoes, chemicals and drugs, and rubber tires. In Illinois employment decreased 1.2 per cent, notable declines coming in men's clothing, agricultural implements, and shoes.

The stage appears to be set for growing labor difficulties. Prices of consumers' goods will soon begin to follow the decline in the more basic materials, and the cost of living is already on the down grade. Nevertheless, laborers are demanding that wages be maintained, or even increased. This makes an impossible situation and labor disturbances are almost certain to increase in frequency from now on.

The fundamental difficulty in American industry today is the existence of a war-stimulated overcapacity in many basic lines of industry. We are geared to produce more steel, copper, leather, textiles, automobiles, wheat, and many other products, than can normally be consumed by the present population. The existence of great supplies of money and credit has facilitated the prolongation of this condition. In the course of time the growth of population will tend to reduce the seriousness of the situation. During the next year or two, however, this maladjustment in our industrial equipment is going to be the fundamental difficulty.

With overcapacity and with increasing stocks of most basic commodities; with decreasing wholesale prices and employment of labor; the most that can be hoped for at present is a gradual stabilization of industry on a considerably lower level than obtained throughout most of 1923.

Recent Developments

1. The trend of building activity is downward.
2. Unfilled steel orders have declined very sharply.
3. Production in basic industries is decreasing.
4. The employment of labor is decreasing.
5. Bank debits have decreased.
6. Business failures have steadily increased.

Favorable Factors

1. The rapid checking of overproduction.
2. Greater stability in prices.
3. Increased exports and imports (Fig. 7).
4. Increased April retail trade, which, however, is probably temporary (Fig. 10).
5. Lower cost of living (Fig. 14).
6. Widespread knowledge of existing conditions.

Unfavorable Factors

1. Declining prices (Fig. 11).
2. Increased business failures (Fig. 12).
3. Termination of the building boom (Fig. 6).
4. Unfavorable outlook for automobile and subsidiary manufacturers.
5. Sharp decline in unfilled steel orders (Fig. 3).
6. Decreased employment (Fig. 15).
7. Increased stocks of basic commodities (Table 1).
8. Decreased bank debits (Fig. 9).

The increase in retail trade is probably due to the lateness of the Easter season. Several of the favorable and unfavorable factors remain unchanged from last month.

Future Dangers

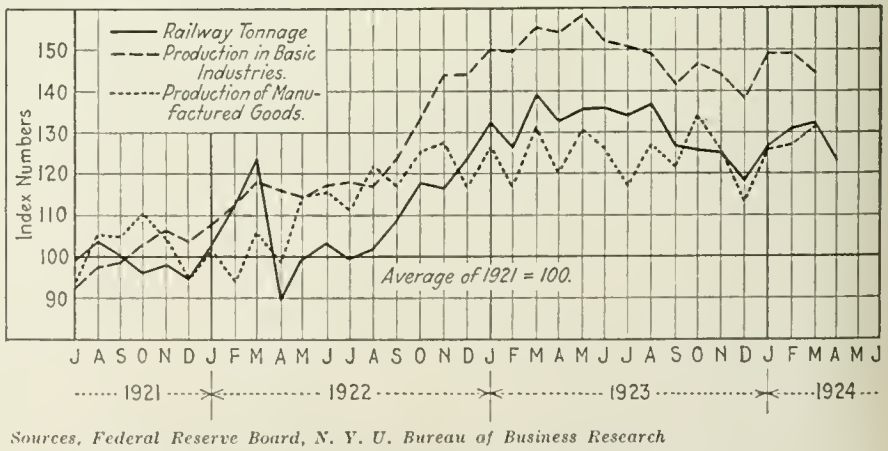
1. Wages too high, with necessity of reducing costs to meet European competition.
2. Strikes and labor difficulties.
3. Strained credit due to sales "on time".
4. Possibility of third party developments leading to uneconomic class legislation, unbalanced budgets, etc.
5. Increased competition from Europe.
6. Withdrawal of European capital.
7. Inflation based on borrowing for soldiers bonus, farm relief, etc.

A word of warning against professional optimists: many statements appearing in the press and magazines paint too bright a picture. The same persons who now proclaim against making comparisons with the spring of 1923, are the ones who did not hesitate to compare that period with 1921. The talk of blaming Congress for the existing business conditions is not sound. The confusion and clash of interests in Congress is a result—not a cause—of the conflict of interests in industry. The total amount of profits in the nation is smaller, and farmers, laborers, railways, and others are selfishly struggling to get relief. The real trouble, in so far as Congress is concerned, is that during election years Congress ceases to be rational and is apt to make wild moves for the sake of votes.

Production and Stocks of Commodities

Falling Off in Production: Stocks Still Burdensome

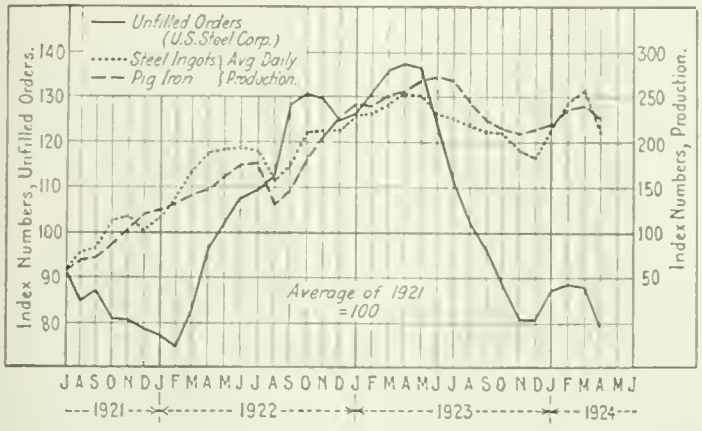
Gasoline stocks increased 8 per cent during March, even after allowing for the usual seasonal change. Auto tire stocks rose 10 per cent, and stocks of raw sugar rose nearly 60 per cent; while leather, newsprint paper, zinc, cotton-



Sources, Federal Reserve Board, N. Y. U. Bureau of Business Research

FIG. 2 RAILWAY TONNAGE AND PRODUCTION IN INDUSTRY

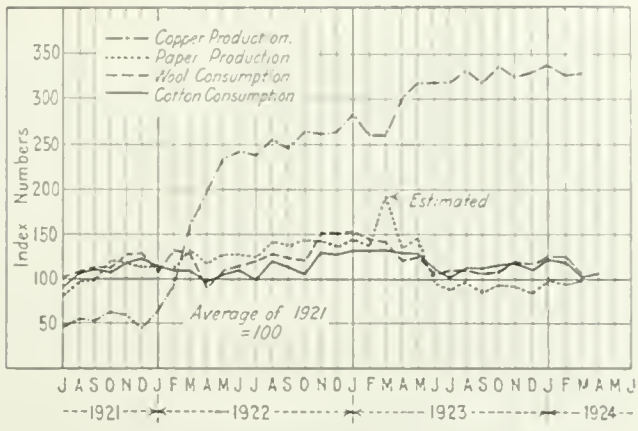
Railway tonnage and production in basic industries corrected for seasonal variation. Production in basic industries has also been corrected for normal growth.


Unfilled Orders (U.S. Steel Corp.)
Steel Ingots \ Avg. Daily
Pig Iron / Production
Index Numbers, Unfilled Orders
Index Numbers, Production
Average of 1921 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921 1922 1923 1924

Sources, Iron Age, American Iron and Steel Institute

FIG. 3 IRON AND STEEL PRODUCTION AND UNFILLED ORDERS

Data for all curves have been corrected for seasonal variation.


Copper Production
Paper Production
Wool Consumption
Cotton Consumption
Index Numbers
Estimated
Average of 1921 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921 1922 1923 1924

Sources, American Bureau of Metal Statistics; American Paper and Pulp Association; Bureau of Census; Dep't of Commerce

FIG. 4 PRODUCTION IN FOUR IMPORTANT INDUSTRIES

Curves for cotton and wool corrected for seasonal variation.

seed oil, and merchant pig iron stocks remained practically unchanged. (See Table 1). In view of the halting demand, the general conclusion that stocks of most basic commodities are somewhat burdensome, seems justified.

Production and Railway Tonnage

Railway Tonnage. During April the tonnage hauled by Class 1 railways decreased sharply. (See Fig. 2). It is estimated that the tonnage figure for April was about 101 million, against over 109 million in March and a similar quantity in April 1923. The adjusted index shown in Fig. 2, which allows for seasonal variation, was 122.7 in April against 132.5 in March (the average for 1921 being 100). This is a decrease of 7.4 per cent.

Production. The physical volume of production in basic industries decreased in March and was 3.3 per cent lower than in February. The volume of manufactured goods, which is not adjusted for seasonal variation, increased.

Conclusion. There has been a rapid reduction in physical volume which is still under way. Immediately this means a curtailment and lower volume of business. This is bound to affect railway tonnage unfavorably. Ultimately this process means relief from overproduction and will bring stabilization and firmer prices.

TABLE 1. STOCKS OF IMPORTANT COMMODITIES ON THE FIRST OF THE MONTH

[1]Average for 1921 = 100. Gasoline, raw sugar and cottonseed oil adjusted for seasonal variation.

MONTH AND YEAR	GASOLINE	LEATHER (Cattle)	ZINC	NEWSPRINT PAPER	AUTOMOBILE TIRES	RAW SUGAR	COTTONSEED OIL	MERCHANT PIG IRON	DEPT. OF COM. INDEX OF STOCKS—31 COMMODITIES
	100 = 630,757,000 gals.	100 = 19,742,000 pieces	100 = 77,202 tons	100 = 30,009 tons	100 = 4,364,000 tires	100 = 114,000 tons	100 = 255,400,000 lbs.	100 = 634,950 tons	100 = 132
July 1921	103	100.5	116.4	88.7	95.2	109.0	118.5	109.5	93.0
Aug.	109	99.5	119.7	85.0	89.2	77.0	123.0	109.5	89.5
Sept.	108	99.5	112.1	90.4	90.2	87.0	129.5	100.0	92.0
Oct.	109	96.4	105.1	109.8	76.6	116.0	60.0	94.0	103.0
Nov.	102	95.0	91.7	76.7	81.2	69.0	71.0	82.0	100.0
Dec.	102	95.2	86.8	77.1	89.6	96.0	84.0	80.0	104.0
Jan. 1922	103	98.5	78.5	79.8	84.7	95.0	92.0	86.0	104.0
Feb.	110	99.0	85.1	88.5	95.6	88.0	84.0	90.5	113.0
Mar.	110	100.7	83.1	92.7	107.5	136.0	82.0	86.0	114.5
Apr.	110	95.4	78.1	93.9	118.8	186.0	84.0	84.5	104.0
May	110	101.5	67.0	82.9	125.2	140.0	89.0	70.0	94.0
June	111	101.6	52.3	82.6	126.6	105.0	82.0	52.5	95.5
July	114	98.3	38.3	77.9	115.5	107.0	84.0	49.0	88.0
Aug.	123	97.4	37.1	70.5	110.8	151.0	87.5	38.0	73.5
Sept.	133	91.5	28.0	66.3	106.1	132.0	89.0	25.0	84.0
Oct.	146	90.2	24.4	62.7	105.7	122.0	37.0	23.8	97.0
Nov.	161	87.7	23.4	65.8	107.3	70.0	35.0	25.0	92.0
Dec.	160	85.9	25.3	65.4	113.8	55.0	42.0	29.8	95.0
Jan. 1923	156	85.3	23.6	64.0	105.4	55.0	52.0	35.8	95.5
Feb.	156	84.0	21.5	76.7	107.6	76.0	60.0	43.0	88.5
Mar.	154	82.6	14.1	77.3	119.7	86.0	64.5	44.0	100.0
Apr.	162	81.6	13.0	67.2	129.9	168.0	67.0	38.0	93.0
May	161	81.4	11.6	62.9	139.3	147.0	69.0	41.7	79.0
June	173	82.1	16.9	60.5	159.6	97.0	71.0	53.6	78.0
July	174	82.8	22.2	65.0	161.1	97.0	76.0	72.7	77.5
Aug.	185	83.6	27.5	74.0	148.0	96.2	74.0	97.5	79.5
Sept.	199	84.3	34.4	85.5	138.5	81.8	57.4	111.0	86.5
Oct.	206	84.2	29.6	82.2	123.2	130.4	28.0	121.7	96.0
Nov.	211	85.4	33.4	82.4	111.7	102.8	43.0	131.0	100.0
Dec.	202	85.8	40.3	80.0	107.5	89.8	43.3	141.0	102.0
Jan. 1924	186	87.0	47.3	78.8	99.0	79.0	52.5	145.0	100.0
Feb.	187.5	79.5	52.7	94.6	110.0	54.5	53.5	144.5	100.0
Mar.	188	83.8	48.0	101.0	120.5	90.0	58.5	140.0	105.5
Apr.	203	81.2	41.5	103.0	132.0	143.0	60.2	139.5	.
May	..	..	42.5						

Iron and Steel Production

Production. During April the average daily production of pig iron (see Fig. 3) decreased 5.5 per cent, 40 furnaces going out of blast during that month. The index for March was 240.5, against 227 for April.

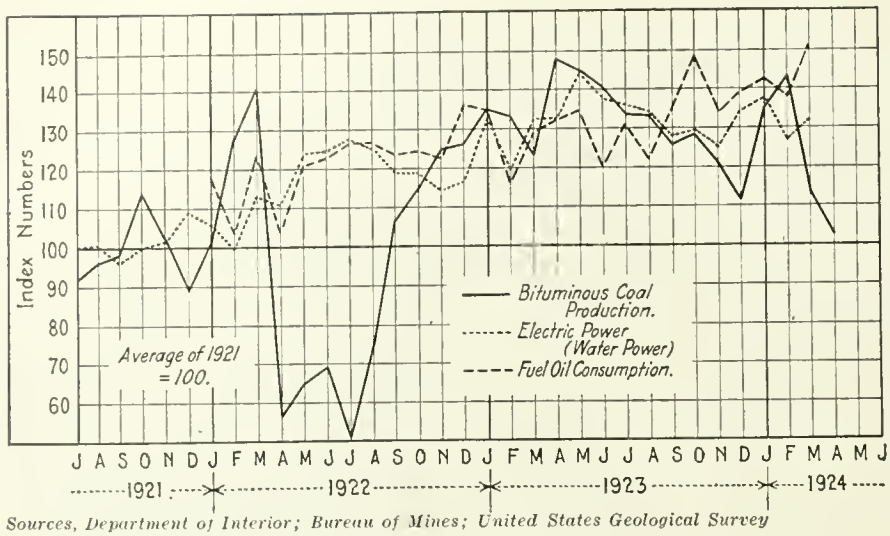
The average daily production of steel ingots declined 18.5 per cent during April, the index, which for March was 257, declining to 210. Further decreases in output are also to be expected in the steel industry, though latest reports indicate some signs of improvement.

Unfilled Orders. Unfilled orders of the United States Steel Corporation on May 1 were 4,208,000 tons, a decrease of 9.5 per cent during April. As was predicted last month, March marked the beginning of the decline of this index, and this decline is expected to continue for another month or two.

Unfilled orders of 108 merchant pig iron furnaces declined 21 per cent during March, and the April data are expected to show a further decline.

Prices. The Iron Age composite steel price on May 13 was 2.639 cents per lb., a decline of 0.112 of a cent from the price on March 11. The composite iron price was $21.79 per ton as against $22.50 on March 11.

Conclusion. The present trends of production, orders, and prices in this industry are in line with the trends of the other major industries, and further slow declines in prices may be expected. The unfilled steel orders are now at practically the lowest level reached in 1921.



Sources, Department of Interior; Bureau of Mines; United States Geological Survey

FIG. 5 FUEL AND POWER PRODUCTION
Bituminous coal and electric power corrected for seasonal variation.

Production in Important Industries

Copper. The index of copper production during March showed a very slight increase over that of the preceding month and indications are of stabilization in the output of this industry. (See Fig. 4). Output is still too large in comparison with demand to allow any strength in the market.

Paper. The index of paper production rose again during March, and is now at the same level as it was in January. The paper outlook is fair, but continued high levels of production may cause accumulation of stocks, and consequent pressure on prices. An increase in newsprint stocks is shown in Table 1.

Wool. The index of wool consumption during March declined 16 per cent from the level of February, and indicates the readjustment which is still going on in this industry. Prices have been weaker lately. While the woolen industry is probably the strongest in the textile group, the outlook is not bright.

Cotton Consumption. The index of cotton consumption, contrary to expectations, rose from 103.3 in March to 106.6 in April, an increase of 3 per cent. The actual number of bales consumed decreased slightly, but the decrease was less than usual in April. As production has been much curtailed in New England, the continued activity seems to be mainly in the South. Probably the bottom has been reached.

Fuel and Power

Coal. The index of bituminous coal production (Fig. 5) declined further during April. The index was 102.5 on April 30, 10 per cent below the March 31 level. Shipments of coal are decreasing, according to the Geological Survey, due probably to decreased demand and use of private stocks. With no danger of strikes, this industry is probably facing the reorganization which it needs so greatly. Coal prices, however, are probably now at bottom levels.

Fuel Oil. The index of fuel oil consumption rose from 138 for February to 151 for March, an increase of 9 per cent. This index has shown a pronounced upward trend throughout the last two years and did not show a decline in the spring of 1923, as did the indexes for hydroelectric power and coal production.

Hydroelectric Power. The index of hydroelectric power showed a slight rise —4 per cent—during March. This index has been corrected for the normal seasonal change, but the spring season has not been normal and it is probable that the rise in the index is partly due to seasonal conditions.

Building Activity in April

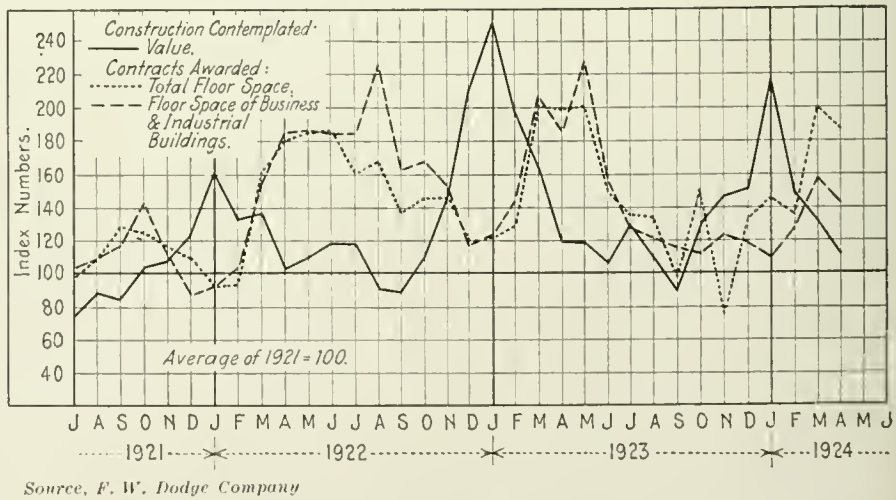
Contemplated Construction. According to the F. W. Dodge Company, contemplated construction in 36 states during April declined 16.5 per cent from the March level. April is the third successive month to show a decline (Fig. 6).

Contracts Awarded. The Bureau has computed a new index, corrected for seasonal variation, of total floor space in contracts awarded. The index was not prepared in time to be placed on the graph, and so the data are given here:

1923	1924			
Dec.	Jan.	Feb.	March	Apr.
155	230	218	201	161

The uncorrected index of business and industrial building for April is 142.5, as compared with 158 in March. It is 23 per cent below the index for April 1923.

Conclusion. The continued decline of the best indexes of building activity emphasizes the conclusion that there will be no building boom this year, but rather a decline. This movement largely accounts for the inactivity in the structural steel markets.



Source, F. W. Dodge Company

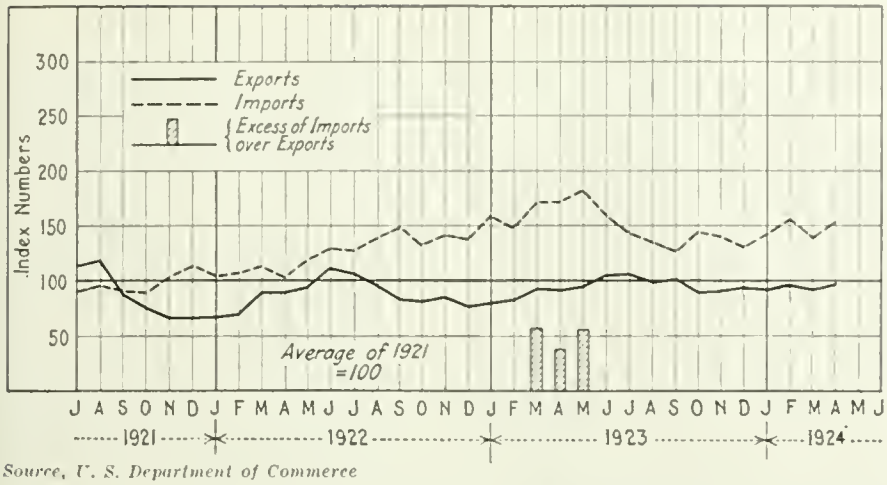
FIG. 6 BUILDING CONSTRUCTION AND FLOOR SPACE IN CONTRACTS AWARDED
Construction contemplated corrected for seasonal variation.

Trend of Trade and Finance

Price Drop Slows Down: Trade Rallies Temporarily

Imports. Merchandise imports for April were $324,000,000, a gain of less than 1 per cent over March figures. After adjustment for normal seasonal change, however, our index of imports rose from 137.8 for March to 150.2 for April, a gain of 9 per cent. (See Fig. 7).

Exports. Merchandise exports during April amounted to $343,000,000, a gain of nearly 1 per cent over March exports.



Source, U. S. Department of Commerce

FIG. 7 FOREIGN TRADE OF THE UNITED STATES

All data have been corrected for seasonal variation.

The adjusted index rose from 93.3 in March to 96.6 in April.

Conclusion. Merchandise imports are running closer to exports. April foreign trade figures show a continued tendency for the monthly favorable balance to narrow. The export figures continue to be affected by the high price of cotton.

New York Stock Exchange

As suggested a month ago, there was some recovery in stocks about the middle of April on account of oversold conditions then existing in the market. (See Fig. 8). The daily average price of 50 stocks for the week ended April 19 was 83.36. In the week ended May 10, the average price gained a little over one point and stood at 84.84. On May 15, the average was 83.73.

Phenomenal dullness has characterized the stock market. The average number of shares traded daily in the week of May 10 was 574,755. This is the lowest average since the week ended October 27, 1923. The former low level came just at the end of a long decline and preceded a rise. At present, however, the volume of shares traded tends to fall off on rises in price and no sustained advance is in sight.

Bank Debits and Postal Receipts

Bank Debits. The April adjusted index of average weekly debits to individual accounts is 123.4 as compared with 128.7 for March. It is apparent that this index reached its peak last month and is now on a downward trend.

Postal Receipts. The unadjusted index of postal receipts for 50 selected cities declined about 2 per cent. This drop, however, was considerably less than the usual seasonal loss during April. As a result the adjusted index shows a gain from 120.3 for March to 127.4 for April. The latter figure is the highest in the period covered by Fig. 9.

Conclusion. While postal receipts have gained, bank debits have begun to register a falling off in the volume of business. This divergence of the two indexes is usual. Of the two, the index of bank debits has been the more reliable, and the considerable decline in this index in April is considered significant. It is anticipated that the volume of business, as reflected by both of these indexes, will decline during the summer months.

Retail Trade

Mail Order Sales. Total April sales of the two leading mail order houses were nearly $34,000,000, a gain of about 7½ per cent over March business. Mail order sales are normally about 9 per cent less in April than in March. As a result of this movement against the normal seasonal trend during April, the adjusted index rose from 135.2 for March to 159.9 for April.

Chain Store Sales. April sales of the four leading chain store systems

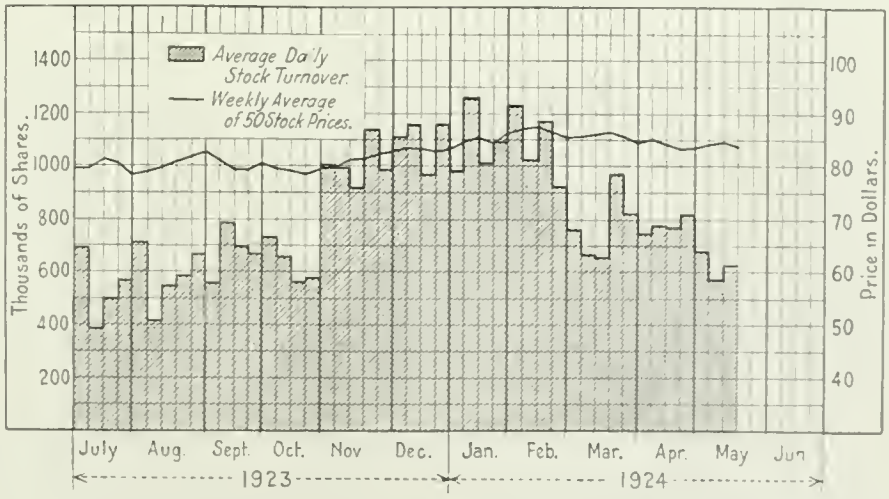
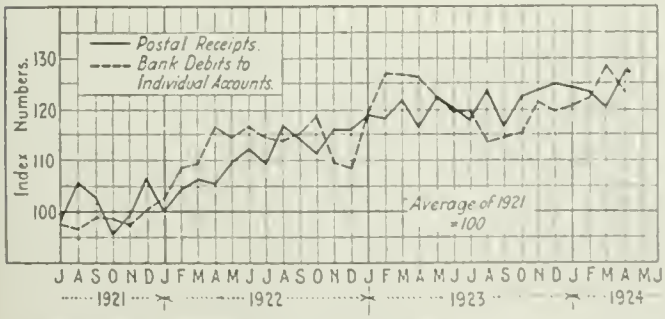


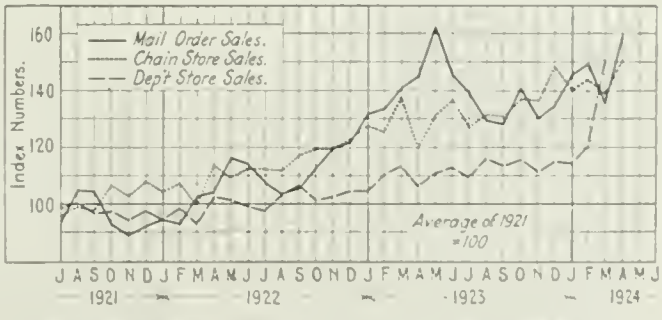
FIG. 8 STOCK TURNOVER AND PRICES ON NEW YORK STOCK EXCHANGE


Postal Receipts.
Bank Debits to Individual Accounts.
Index Numbers.
130
120
110
100
Average of 1921 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Federal Reserve Board; Post Office Dep't.

FIG. 9 BANK DEBITS AND POSTAL RECEIPTS

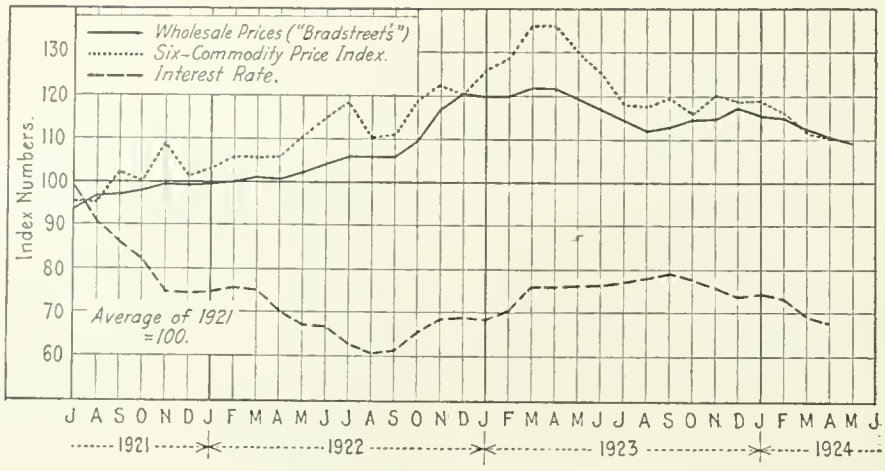
The data for both curves have been corrected for seasonal variation.


Mail Order Sales.
Chain Store Sales.
Dep't Store Sales.
Index Numbers.
160
140
120
100
Average of 1921 =100
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, Commercial and Financial Chronicle; Federal Reserve Board

FIG. 10 SALES OF MAIL ORDER, CHAIN AND DEPARTMENT STORES

The data given cover 2 mail order houses, 4 chain stores, and 306 department stores, and are corrected for seasonal variation.



Sources. Commercial and Financial Chronicle, Federal Reserve Board

FIG. 11 WHOLESALE PRICES AND INTEREST RATE

Interest rate is the monthly average, corrected for seasonal variation.

totaled $29,726,000, a gain of about 9 per cent over sales for March. The normal seasonal change during April amounts to but a small fraction of 1 per cent. As a result, the index rose from 138.8 for March to 150.6 for April.

Department Store Sales. Latest available figures on department store sales are for the month of March. During that month the adjusted index dropped to 105.9 from 120.5 in February.

The Bureau's sensitive six-commodity index averaged 110.2 during the month of April against 111.5 in March and 136.1 in April 1923.

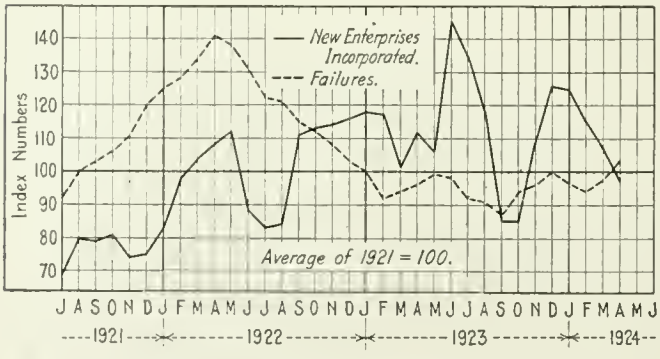
The most important declines have occurred in metals, hides and leather, livestock, and naval stores. It should be noted, however, that five out of the 12 groups of commodities showed small advances during April, including coal and coke and in textiles, which led the heavy production and stocks of basic commodities, the existing price decline is likely to go a little further. Buyers are holding off, waiting for the bottom, and this psychological condition, as usual, tends to carry prices further downward than they would otherwise go. The present rapid curtailment in production, especially in iron and steel, may be counted on to check the declining tendency, and equilibrium seems likely to be reached in another month or two—say about the middle of the year.

The money market will continue weak for some months. Just now conditions are not dissimilar to those following the depression of 1921, when money was cheap but nobody could use it.

New Enterprises and Failures

New Enterprises. As measured by the capitalization of new companies, the establishment of new enterprises slumped sharply in April and reached the lowest level attained since June 1923.

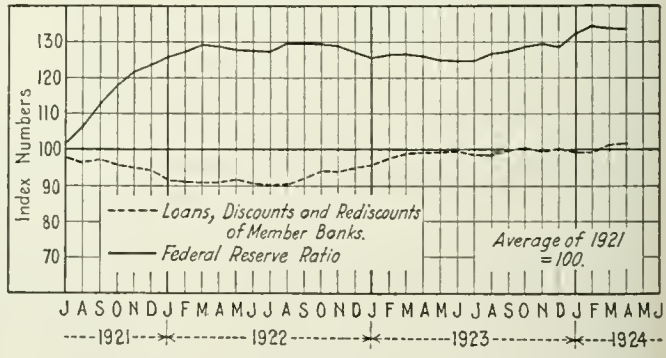
Failures. The number of business failures as reported by Dun's showed a considerable increase during April. The index of such failures, which eliminates the usual seasonal variation, has steadily gained throughout 1924; the figures for



Sources, Dun's Review; N. Y. Journal of Commerce

FIG. 12 NEW ENTERPRISES AND BUSINESS FAILURES

Both curves adjusted for seasonal variation. Values plotted are the 3 months' moving average.



Source, Federal Reserve Board

FIG. 13 BANK CREDIT AND FEDERAL RESERVE RATIO

Federal reserve ratio is ratio of total reserves to note and deposit liabilities and has been corrected for seasonal variation.

Conclusion. The rather large gains made in retail trade during April may be attributed to late spring weather and the Easter buying season.

Retail trade is now near its peak for the present cycle, and probably sales will decline within a few months.

Prices and Interest Rate

Prices. As shown in Fig. 11, the trend of commodity prices is still downward. On May 1, Bradstreet's index of wholesale commodity prices, based on the average of 1921 as 100, stood at 111.6. This compares with 112.4 in the preceding month and 121.4 a year ago.

decline and may lead in recovery.

Interest Rate. The interest rate continued its decline during April. The unadjusted rate on prime commercial paper in the New York market averaged 4½ per cent in April and has since fallen to 4¼ per cent. The index number, based on the average for 1921 as 100, was 67.9 in April, which is the lowest level reached since September 1922. The reduction in the discount rate of the Federal Reserve Bank of New York to 4 per cent is indicative of the present small demand for funds.

Conclusion. Because of the existing high degree of uncertainty as to the future trend of business, coupled with the four months beginning with January being as follows: 92, 96, 106, 109, the latter the largest since January 1922.

Conclusion. A glance at Fig. 12 indicates that the situation is now somewhat similar to that which existed early in the fall of 1923. The curve showing the trend of new enterprises is now below that showing business failures. The situation at present, however, is less promising than it was then, for the reason that the number of failures is farther above the normal figure than it was in the 1923 recession. The foregoing indexes indicate forcibly the seriousness of the present slump in business, and show that no early recovery is probable.

Bank Credit

Loans and Discounts. Total loans and discounts of the 755 reporting member banks of the federal reserve system were $12,121,000 on April 30, a slight gain over the month preceding. The April index is 101.6, compared with 101.2 for March. (See Fig. 13).

Federal Reserve Ratio. After eliminating normal month-to-month variation, the April index of the ratio of reserves to deposit and federal reserve note liabilities combined declined to 133.7 from the March position of 133.9 —an insignificant change.

Conclusion. The April changes in these two indexes are not important. They emphasize the continued tendency of member banks to handle the demand for credit without recourse to the federal reserve system. A continuation of abundant credit is indicated.

Wage and Employment Situation

Employment Decreasing: Earnings Maintain High Level

Earnings and Cost of Living

Fig. 14 shows the trend of average weekly earnings and the cost of living.

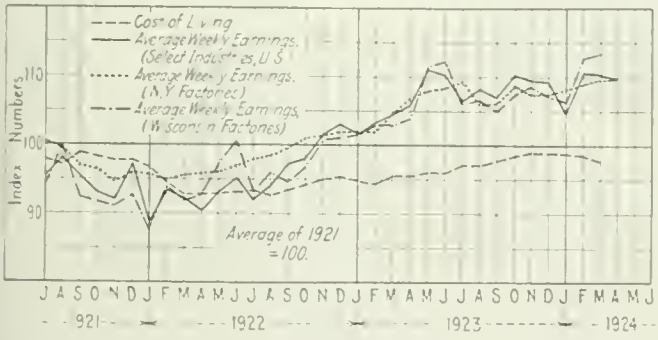
New York State. After adjustment for seasonal variation, the index of average weekly earnings increased slightly. It now stands at a new high point, approximately 10 per cent above the average for 1921. Actually, average earnings of New York City workers decreased from $28.16 to $27.70 per week in April.

Wisconsin. The index of earnings, which is corrected for monthly changes, made a small gain in March but dropped 2 per cent in April. This curve is now approximately 13 per cent above its average for 1921.

Selected Industries in the United States. This index is not adjusted for seasonal changes. The April figures show a decline of 0.4 per cent. However, this decline is probably seasonal, and is due largely to decreased per capita earnings of 5.2 per cent in men's clothing. Seventeen of the 52 industries reporting show increased per capita earnings in April over March.

Cost of Living. The cost of living decreased slightly in both March and April. The index is now 3 per cent below its average during 1921.

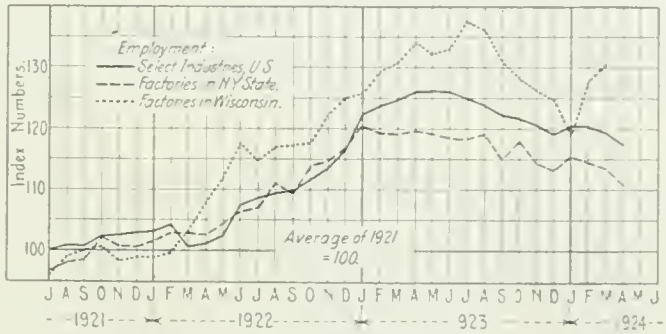
Conclusion. Labor's purchasing power continues high. Taking the country as a whole, the percentage of increase in weekly earnings since 1921 has been 13 points greater than that in cost of living. It is unlikely, however, with the present slackening in industry that this margin can continue.


Cost of Living
Average Weekly Earnings, (Select Industries, U S
Average Weekly Earnings, (N.Y. Factories)
Average Weekly Earnings, (Wisconsin Factories)
Index Numbers
110
100
90
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
1923
1924

Sources, U. S. Bureau of Labor Statistics; N. Y. State Dep't of Labor; Industrial Commission of Wisconsin; National Industrial Conference Boord

FIG. 14 WAGES AND COST OF LIVING

New York and Wisconsin data corrected for seasonal variation.


Employment:
Select Industries, U S
Factories in N Y State.
Factories in Wisconsin.
Index Numbers
130
120
110
100
Average of 1921 = 100.
J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1921
1922
923
924

Sources, U. S. Bureau of Labor Statistics; N. Y. State Dep't of Labor; Industrial Commission of Wisconsin

FIG. 15 THE TREND OF EMPLOYMENT

Data for all curves have been corrected for seasonal variation.

The Employment Trend

New York State. The adjusted index of employment in this state receded from 113.4 to 110.8 in April. (See Fig. 15). The actual percentage decline was even greater, as a normal decrease of 0.9 per cent has been allowed for. The reductions apply to most of the New York industries and to all of the important manufacturing districts.

Wisconsin. April figures show slightly decreased employment. The index, after allowances for seasonal changes, stands 29.7 per cent above the average for 1921.

United States. The adjusted April index decreased slightly for the second consecutive month. Only 10 of the selected 52 industries showed increases in employment, and but two of these were of considerable size. These were the brick industry with 8.5 per cent increase in April, and the ice cream industry with 7.7 per cent. Men's clothing led in decreased employment, 11.4 per cent.

Conclusion. Latest reports on employment indicate a slackening of industry since the peak of employment a year ago. In both the United States and New York State numbers employed are nearly 10 per cent less than in April 1923. However, both are well above the average for 1921.

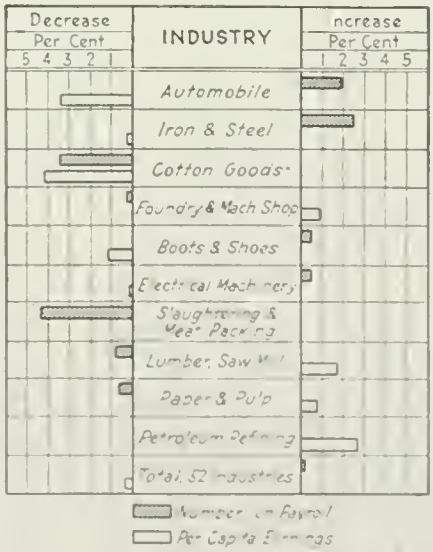


FIG. 16 TREND OF EMPLOYMENT AND EARNINGS, MARCH 1924

Employment and Earnings in Selected Industries

In Fig. 16 is shown the trend of employment and earnings in 10 leading industries during March.

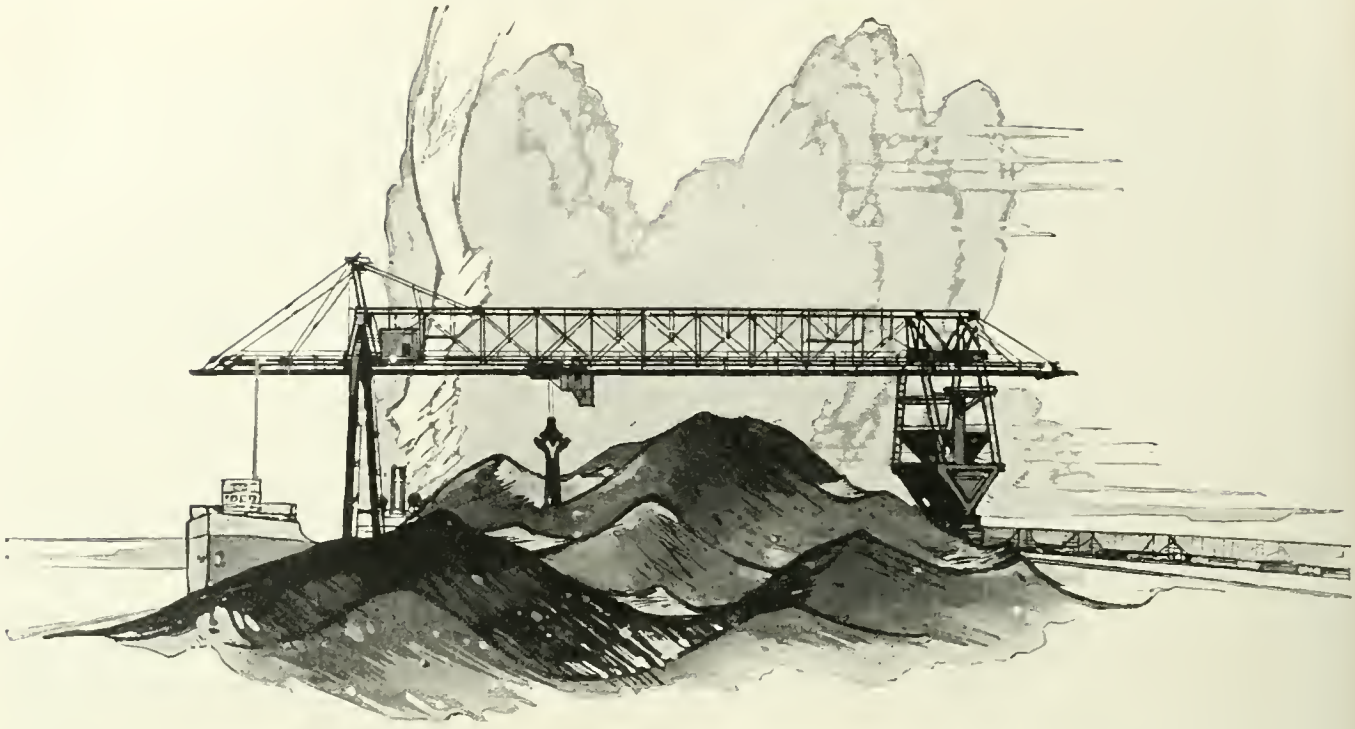
Employment. Five of the industries showed increased employment. The remaining five industries showed decreased numbers on pay-rolls.

Per Capita Earnings. One-half of the 10 industries analyzed showed increased earnings, the others decreases.

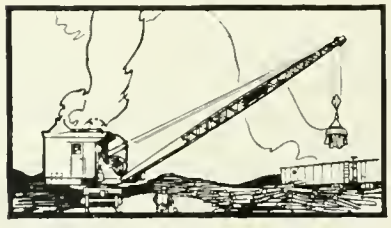
Immigration and Emigration

Both immigration and emigration increased in March. The figures follow:

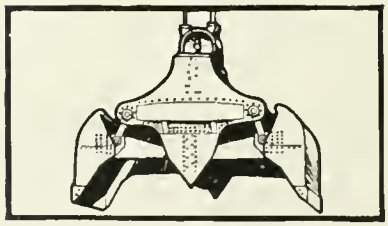
	Immigrants	Emigrants	Net Gain
Mar. 1923..	53,330	10,630	42,700
Feb. 1924..	29,901	3,706	26,195
Mar. 1924..	35,585	4,202	31,383



This is a Brownhoist Bridge Crane installed for unloading coal from boats. Brownhoist makes such cranes in a wide range of types and capacities



Brownhoist makes locomotive cranes operated by steam, electricity and gasoline engine. Capacities from 5 to 40 tons



Brownhoist Link-type Bucket. Made from ½ yard to 15 ton capacities

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Lowered Handling Costs *Mean Higher Net Profits*

You have no handling problem, be it large or small, which cannot be solved in a way that will bring increased net profits. For over 40 years Brownhoist engineers have been doing two things—

Working out more economical *plans and methods* of handling materials.

Designing machinery to carry out these plans—to do the job with minimum upkeep and operating costs.

Today, whether your material-handling problem be in connection with a mill or factory, a construction job, or a steamship or rail terminal, there is Brownhoist equipment available to save you expense and guarantee uninterrupted service.

Back of the equipment stands the long experience of the Brownhoist engineering staff. Brownhoist engineers will be glad to work out with you plans for more economical operation. This advice is yours for the asking.

The Brown Hoisting Machinery Co., *Cleveland, Ohio*

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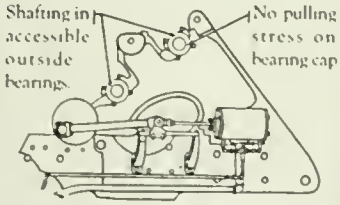
BROWNHOIST

MATERIAL HANDLING EQUIPMENT

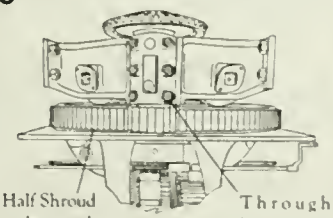
Why Industrials Excel

9 REVERSING ENGINES



Horizontal reversing engines make crane available for all services. Ropes unwind by power. Heavy loads are handled with security and accuracy.

10 EXTERNAL SLEWING RACK



The hard-working slewing gears are outside all other machinery, allowing easy access. Slewing pinion is in front where tipping under load is least

Midnight—and still working

THE MECHANICAL ENERGY of an INDUSTRIAL locomotive crane surpasses almost any quantity of human labor. The crane handles all bulk, magnetic and unit material in less time than it takes from 25 to 50 laborers, and it can do this twenty-four hours a day—day after day. Three shifts of men would be required for such continuous service.

INDUSTRIALS are equal to the hardest sort of uninterrupted service because they are the finest locomotive cranes in the world. They are built for executives who know the economy of quality—who are willing to pay a little more at first to save a great deal later. The exacting workmanship and the high grade materials entering into their manufacture endow them with the ability to withstand service that would rapidly ruin ordinary equipment.

It is worth a great deal to know that long after the acknowledged span of crane usefulness, the INDUSTRIAL you buy will be delivering efficient, uninterrupted service.

The 17 types of INDUSTRIALS, capacities 5 to 200 tons, are all fully illustrated and described in our Golden Anniversary Catalog. It will be gladly forwarded to you upon request

INDUSTRIAL WORKS

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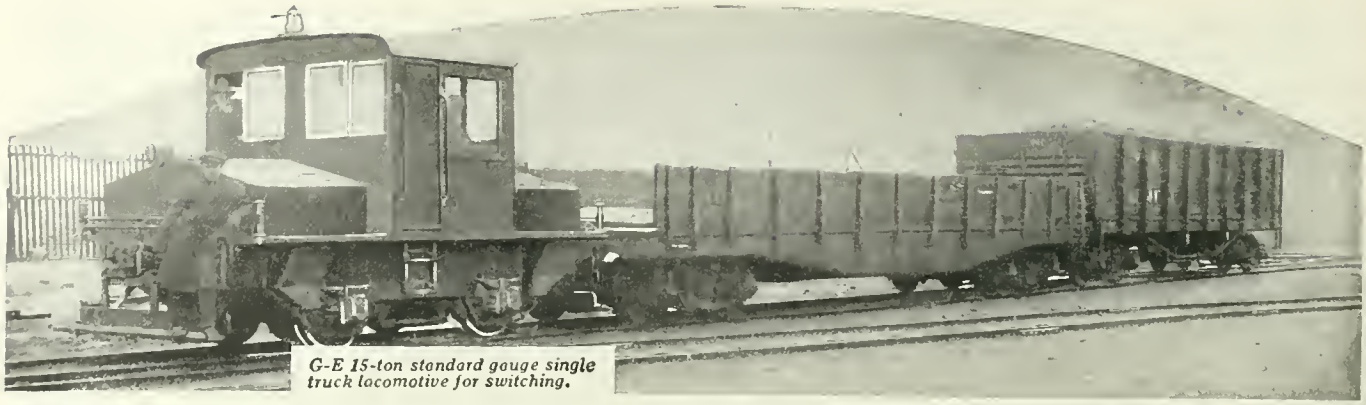
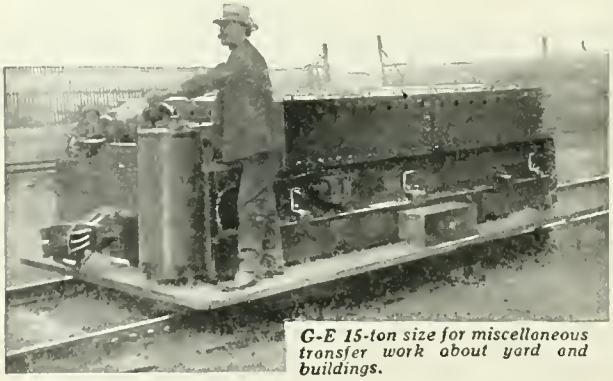
Locomotive Cranes, 5 to 200 Tons—Transfer, Pillar & Gantry Cranes
Railway Pile Drivers—Combination Crane Pile Drivers—Transfer Tables
Portable Rail Saws—Grab Buckets—Magnets—Steam Pile Hammers

INDUSTRIAL LOCOMOTIVE CRANES



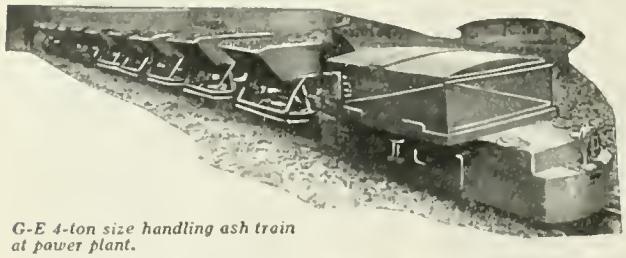
G-E 15-ton standard gauge single truck locomotive for switching.

G-E 40-ton combination storage battery and trolley locomotive for heavy duty yard service.



G-E 15-ton size for miscellaneous transfer work about yard and buildings.

G-E 10-ton platform capacity type for exchanging material between buildings.



G-E 4-ton size handling ash train at power plant.

There Are Many Uses For G-E Storage Battery Locomotives

Whether switching loaded freight cars—transferring raw material, or partially finished products from building to building—hauling ashes or refuse—G-E Storage Battery Locomotives speed up production through facilitating transportation of materials.

With this type of electric locomotive, neither trolley nor third rail is required—and it is possible to reach points in shops, yard or mill where the use of other methods of haulage is not feasible. A G-E Storage Battery Locomotive can be run inside of building and in other localities where the smoke and fire risk of a steam locomotive would forbid its use.

The large type G-E Storage Battery Locomotives are now demonstrating that the yard shifting work in industries can be handled at a lower cost per ton mile.

Interesting and valuable detail of the uses of electric locomotives for industrial haulage is contained in *Bulletin No. 44251* which will be mailed you free upon your request. Write for it today.

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43B-773

MANAGEMENT
AND
ADMINISTRATION

VOLUME VII JUNE, 1924 NUMBER 6

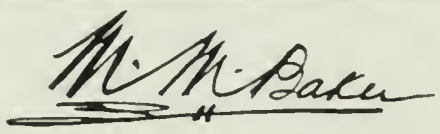
Results of Scientific Management from the Viewpoint of Corporate Control

By M. M. BAKER

Vice President and Manager, Peoria Plant, The Holt Manufacturing Company

Index Number
658.5 Production control

I AM convinced that no plant dealing with a large tonnage of material and a substantial personnel, can be operated to its maximum possibilities in the interest of its stockholders, upon any basis other than that of scientific management, applied in a definite and vigorous fashion. This conviction is based on my experience in the operation of the Peoria plant of The Holt Manufacturing Company, and a comparison of results in it under all types of management. This experience covered a period prior to the war, during which we operated according to the conventional and generally accepted methods of the time; then came the rough-and-tumble of war production; and finally a period of five and one-half years during which the plant has learned and applied the principles of scientific management. I know whereof I speak.



The attention of the management of this plant was first called to the relative importance of scientific management through certain opposition to it, expressed by a group of workmen. These men vigorously declared that any effort in that direction was fundamentally opposed to the broad principles of production upon which they were working at the time. These principles, I appreciate, were vague and indefinite. The education of the management in matters of scientific control had been sadly neglected, and the opposition of the men immediately prompted an investigation to find out more about it. At that time it appeared to us to be a basis upon which the operation of a plant of a character such as ours might be conducted in a more orderly and definite fashion.

It is to be assumed that those accountable for results in matters of production in our own organization, were at that time satisfied that the methods then in vogue—which I am sure differed little, if any, from the usual methods employed in the conduct of the average business,—were quite adequate. I did not appreciate, until our attention was called to some of the startling factors entering into matters of production control in a scientifically operated institution, that somewhere we might find a definite basis upon which the work of our plant might be substantially improved. In canvassing the situation I learned that there were then a few plants in this country that were being conducted in a scientific manner. In these plants, we learned, all matters of procedure were predetermined as to final results, and the work in every branch was brought under control, and this control uniformly maintained to accomplish the desired results.

In 1916, after a most interesting conference with one of the most enthusiastic exponents of scientific management, and after personally reviewing the results of several years' conduct of a plant under such control, we arrived at our first decision in this matter. This was a decision to bring about, as nearly as possible, a similar condition in our own

plant. A decision having once been reached, the principal difficulties that we were later to encounter were soon approached. The first and most outstanding of these was the matter of interesting, in our own affairs, a man of experience, to take charge of the undertaking. That task alone covered the best part of three years, with but one prospect in sight—due not entirely to the limitations of this particular field of endeavor, but primarily by reason of our having selected for our job the man that it required. It took this period of time to convince Colonel George D. Babcock that scientific management might be employed and successfully carried out in an industry, the very character of which had been based upon antiquated methods. The thought also was presented that perhaps those fundamentals that were being incorporated in concerns of larger output of a repetitive character, afforded an opportunity for accomplishment which the heavy machinery business at that time did not seem to present.

The determination upon the part of those concerned in war production, in which this plant was chiefly engaged during 1917 and 1918, had a general trend toward closely organized shops, mostly because this was the line of least resistance. Although our own plant went through its war activities on the open shop basis, nevertheless a large percentage of our workmen were men affiliated with various labor organizations, most of which were opposed fundamentally to any tendency toward scientific management or a trend in the direction of Taylor methods of industrial operations as a foundation for the same.

Burden Upon the Manufacturing Executive

The burden of the second obstacle to be overcome fell upon Colonel Babcock, the executive who had taken charge of this matter. His difficulty lay in the necessity of gaining the confidence of workmen whose training had been along entirely different lines, and practically all of whom had formed prejudices with respect to the question of definite control of their activities. Considerable time and patience were required to clear up this situation, and to secure their confidence and co-operation in such a manner as to make possible the task undertaken. In due course, the principal work relating to the determining of the time required and the scheduling of work, was compiled by men drawn from the Holt shops in a most satisfactory manner. By their constructive work and the co-operation of others, the carrying out of the program was made entirely possible to the point where all concerned soon were in entire accord as to the importance of this move, and its advantage to workers, and management as well, was apparent.

As a striking feature in this connection, it may be noted that some of the most outstanding individuals of the workers' group who had had misgivings as to the possibility of undertaking so drastic a change had, within a year from the installation of the first definite principles of scientific management in the shop, attended a meeting of the Taylor Society held at Harvard University. One of these men went so far as to speak in behalf of the workers at that meeting. He outlined how the principles under which we were then operating had so favorably reacted on the men that they had refused to join a general sympathetic strike, even in the face of an organized demonstration to force them to do so. Soon after his return this man was selected by his fellow-workers as President of the Trades and Labor Assembly in the Peoria district. During his entire term of office there was little or no occasion for dissension between the management and the men at this plant over methods of shop practice. His decisions were invariably tempered, if not based, upon those fundamentals of scientific management which he had, within a short space of time, acquired in a general way and endorsed emphatically as of outstanding benefit to workers, and employers as well, in so far as the betterment of the conditions throughout the organization was concerned.

Having decided to place our plant under scientific management, and a proper head for this important branch of work having been obtained, and the objections offered upon the part of the men who were not informed upon the principles involved in an undertaking of this kind having been overcome, the next and by no means the least problem encountered was that with respect to the matter of our own official family. The tendency here was to withhold judgment as to the desirability of this undertaking, and there were inclinations upon many occasions either to modify or discontinue certain branches of the work, which course would have tended to stultify our efforts as a whole. The time required to gain the entire confidence, support, and endorsement to the undertaking, covered the best part of five years. None of the officials at this time is disposed in the slightest measure to return to our previous methods of shop management.

In particular, scientific management has accomplished this for us: We have absolute and definite control of our shop operations; we can today determine the serial numbers of the product that will leave the assembly floor on a particular day next December, with the full assurance that these particular items of product will be delivered on that particular day and no other. We have greatly improved the quality of our product, and effected a substantial reduction in its cost. We have eliminated labor troubles and today have a body of workers that is loyal and efficient, and which will challenge comparison with other workers in the industry anywhere.

As to the general effect of scientific management upon the entire organization of an institution of this character, it might be well to say that the influence is more far-reaching than might be first assumed. It is my firm conviction that corporate control is more dependent upon scientific management so far as plant operations may be concerned, than any other one factor that enters into the financing for the corporation's requirements, sale of its product, and in fact determinations as to the desirability of setting up advertising budgets and other matters of this nature. All of these are outstanding in the conduct of the manufacturing institution as a whole, and must necessarily be predetermined under a plan of this kind. All of these eventually become a part of scientific management, to the end that the institution is controlled in a definite manner and one that can be understood by all.

Building Tractors Under Scientific Management

Methods by Which the Holt Manufacturing Company Has Made a Remarkable Production Record

By GEORGE D. BABCOCK

Manufacturing Executive, Holt Mfg. Co.

Index Number
658.9:629.113 Tractor manufacture. Management

THE Holt Manufacturing Company at its Peoria Plant, has attained a record believed to be unequaled in the history of manufacturing management.

For 600 consecutive working days, the production of the factory has exactly equaled daily the schedule of programs laid out not less than four months preceding. That is, four months earlier, the requirement was laid down that certain definite items of product should be completed and shipped on a particular day. This requirement has been met without a single failure for the period stated above.

This record is not an accident. On the contrary it has resulted from careful planning of the most intensive character. Briefly, the reasons for this performance can be summed up as follows:

1. By standardized methods which in themselves are really useful.
2. By the training of an organization to believe that this is true, and to be willing to cooperate to the extent of carrying it out.
3. Readiness of anyone in the organization to assume duties outside of his regular line of work in regard to matters requiring urgent attention.
4. Final appreciation of the management that uniform control, not alone does not depreciate the quality of product, but enhances it, and that such control is more economical than variable control.

The product of the company consists of "Caterpillar" tractors, of the general type shown in Fig. 2. Other illustrations show the character of work that is performed by the tractor, and give an idea of the necessity of rugged construction and careful design to meet the various conditions of all sorts of ground, weather, and methods of handling. In addition, the mechanism must be built with a high degree of precision and to standards fully approaching those of the best automobile practice. It is thus evident that the engineering design must be a matter of careful consideration, and the shop practice must conform to the highest standards of the machinists' trade. (See Figs. 3, 4, 5 and 6.)

The Holt Manufacturing Company was originally established at Stockton, California, about 1892, and the Peoria Plant was started in 1910. Both plants are in operation, but the particular operations described in this series of articles, apply to the Peoria Plant.

Shortly after the outbreak of the Great War, and prior to the entrance of the United States into it, a number of contracts for tractors for military purposes was received from the French, British, and Russian governments. These were of sufficient volume to absorb completely the capacity of the plant. Upon the entrance of the United States into the war, the demand for military tractors immediately increased to immense volume due to orders placed by the United States government. To obtain the maximum of production, plans were immediately laid to extend the plant, and the construction of new buildings was put under way at the earliest possible moment. In addition, contracts were placed with outside manufacturers, chiefly in the automobile industry, to manufacture certain parts and assemblies. The government also entered into contracts with other manufacturers to build tractors complete under the Holt Company's

FIG. 1. ENTRANCE TO PLANT OFFICE OF HOLT MANUFACTURING COMPANY

patents. These facts have a direct bearing on the conditions that obtained after the war, and exercised no little influence on the problem of production and the establishment of scientific management in the plant.

During the war, two complete sizes of tractors were built, including engines, transmissions, and track. Parts were machined for other sizes, the balance being obtained from the outside contractors to assemble the complete tractor. The engines for the later tractors were built in the western plant, which was completely set aside for this purpose. At Peoria, the plant was operating three shifts per day with a maximum number of men that could be placed on the available equipment. A portion of the new building program had been completed, but a large number of the projected buildings were still under construction at the time of the armistice.

FIG. 2 A TRACTOR HAULING LOGS IN THE SOUTHERN SWAMPS

Conditions After the Armistice

The effect of the armistice was an almost complete and immediate cessation of work. The government canceled its contracts, and production fell from the maximum capacity of the plants to practically zero about the first of the year 1919.

The situation confronting the management, as a result of the armistice, was one requiring prompt and drastic action. It had no sales or commercial organization; it had no commercial product; and its manufacturing standards and policies were all on the basis of war conditions. Furthermore, the end of the war had removed the major portion of its market for the product which it was best equipped to manufacture. It was evident that an immediate reorganization along lines could not be made too quickly.

In making the reorganization, the following factors required consideration. They were finally made a matter of record and formally adopted as the program to be followed.

1. Types of product must be determined.
2. Buildings that were to be completed.
3. Equipment to be secured and placed.
4. Flow of material to be established.
5. Labor and housing plans perfected.
6. Schedule of probable output as to quantity and time determined.
7. Mediums, amount, and time of advertising determined.
8. Selling plan and organization formulated.
9. Plan of distribution determined.
10. Arrangements for distribution completed.

In addition to the above, other related activities also were considered. Among these were the training of demonstrators; suitable plans for spare parts maintenance and distribution; and all of the necessary arrangements for control of the foregoing factors.

It is of interest to note here that the above items form a complete outline for the conduct of the business. It is an example of thinking clear through to the end of the problem, rather than an attempt to meet each combination of events as they occur. The results obtained at Peoria are a striking demonstration that thorough and complete analysis obtains more consistently successful results than do the methods of the opportunist, which merely relieve a few emergencies.

A general survey of the situation shows that, so far as product was concerned, the military tractor that the company had been building for the government could be converted to peace-time purposes by means of certain modifications and the elimination of certain features designed for purely military ends. Arrangements accordingly were made whereby a considerable quantity of former government tractors were diverted to the commercial purposes of the Holt Company. These were stripped of their strictly military features and were placed on the market. This was the first step toward providing the company with a product whereby it could meet the demand for tractors for industrial use. It, of course, was but a temporary expedient and the establishment of a definite manufacturing program was essential.

Previous to the entry of the United States into the war, the Holt Company had become interested in scientific management. Several visits had been made by its officials to the plant of the H. H. Franklin Manufacturing Company, where the Franklin automobile is built. Here the writer had applied and was operating the factories under the principles of scientific management. The results accomplished at the Franklin plant, had attracted some attention, and it was felt by the Holt Company's officials that similar methods would prove of benefit to them. The writer was unable to

render any assistance in this connection at the time, and the entry of the United States into the war, involving service in the army on his part, ended all possibilities for the time being of joining the Holt organization.

The signing of the armistice changed the situation and, accordingly, early in January 1919, this connection was made. The condition that then existed has been outlined above. Practically the first work to be done was to formulate a plan for the conduct of the business as a whole. The plan which was eventually decided upon has been outlined above. The next step was obviously to put this plan into effect.

The Problem of Resuming Production

The problem of the types of product to be built was temporarily solved by the adoption of the government military tractors. The second item of the program, the buildings to be completed, required but little consideration, since it was obvious that buildings on which the construction work was almost finished, would suffer less damage completed standing idle, than if left in the unfinished condition. While the buildings had been planned for a war-time production, there was no basis as yet for determining whether or not the production on a peace basis would be of sufficient volume to utilize these buildings. However, it was better to complete them than to permit them to stand unfinished and suffer damage thereby.

FIG. 3 A TRACTOR USED FOR SNOW REMOVAL IN NEW YORK CITY

The equipment to be secured and placed also depended upon the total volume of business that could be built up. This, however, was not a problem of immediate importance.

The principal problem and the one upon which the greatest effort was concentrated was the establishment of a flow of material through the plant, and its assembly into finished tractors. To establish this flow, the easiest method was obviously to continue the production that had been initiated by the government, and which was represented by its canceled contracts, both with the Holt Company and with the outside contractors who were manufacturing under the Holt patents.

The armistice terminated contracts in all stages of completion. Some of the material in the various plants was practically in a finished condition. Other material was absolutely in a rough state. The balance was in a condition anywhere between these two extremes. The situation was further complicated by the fact that some of the contractors were using government-owned tools, jigs, and fixtures. Another complication was due to the use of dissimilar tools and machines for similar operations in the several plants. Consequently when arrangements were made to take over the government obligations for the completion of the tractors which were being built in outside plants, there was received a vast amount of material in various stages of completion, and requiring in some cases vastly different methods for conversion into finished parts. One way out of the difficulty appeared to be the purchase or lease of the government owned tools in the plants of these other contractors. It developed, however, that although there were two sets of tools available, the government would lease but one set. The other set was to be retained under its own control at the various arsenals for use in possible future war production. From the standpoint of the Holt Company, this meant that for a large portion of the unfinished material purchased outside, no tools, jigs, or fixtures were available for machining.

The material shipped in from the outside plants remained the property of the government until it was actually requisitioned for assembly into tractors. This material was shipped into the plant in tremendous volume, and taxed severely all available storage space. It was handled by plant labor which was charged to the government account, and was stored partly in the buildings which were completed by the government and partly in the yard. It was absolutely impossible to check the materials as they were received, and receipts were given subject to correction upon final accounting and invoicing.

It was found that the government records did not give complete information. The government had requisitioned such materials located in outside plants as it had needed. The records had not in all cases been changed to correspond with the requisitions, with the result that many shortages were discovered when the plant called for material from the government stores for its tractor program. Such shortages interfered seriously with the production of tractors, for the reason that they frequently did not materialize until the parts were urgently needed. It was then necessary to initiate the production of these missing parts in the factory, all of which tended to delay production and upset

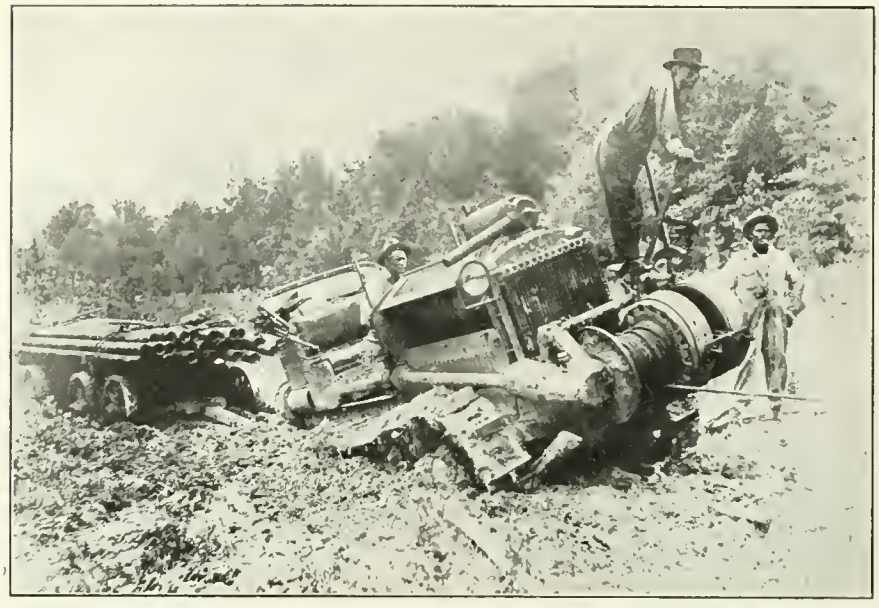


FIG. 4 A TRACTOR HAULING TRUCK THROUGH DEEP MUD

the entire schedule established for tractor deliveries.

Notwithstanding these difficulties, a form of control of production was initiated at a very early date. This control was not an established routine as was obtained in the later developments under scientific management, but was rather a careful study in advance of the requirements of material and labor necessary for the production of a given tractor schedule. It was made effective by a constant follow-up and a checking of shortages in parts on given assemblies from day to day, and the initiation of the necessary steps to correct the shortages as they were uncovered by the investigations.

Personnel Problems

Another discouraging feature of the situation was the conditions relating to personnel. The plant was located in an agricultural community and there was no large reservoir of skilled mechanical labor upon which to draw. The nearest large industrial city was Chicago, and this was so far distant as to be a negligible factor in the labor market. The situation was not so much one of labor that was actually unsuited to the work, but labor which had not acquired the traditions, instincts, and language of the mechanical trades as in the case with men that grow up in a distinctly industrial community. Without this inherited mechanical ability, such as is found in New England and in the neighborhood of industrial districts like those surrounding Cincinnati and Chicago, it is difficult to put across to workers the ideas necessary for effective production in the metal working trades.

The mental attitude of the mechanical force in the plant had some bearing on the post-war conditions. The men had been working strenuously on the war production, and the prevailing slogan, "Get the stuff, regardless of cost," had contributed little to economical improvement. The general excitement of the period, as well, had created some unrest. In the collapse following the armistice, the mental attitude of the workers was badly shaken, and their appreciation of the necessity of rigid economy in industrial operations had to be re-established.

As the highly methodical plans for operation were introduced, the transition from war conditions to those of peace was one of considerable difficulty. The sudden shrinkage in the volume of work naturally caused men to become fearful of losing their jobs, and to make their work last as long as possible. This applied also to the supervisory personnel.

Then, too, there was the influence of a previous supposed failure of scientific management in the district, to be combated. The general attitude, in view of this was, "What's the use? It has been tried once and didn't work." This led not to active opposition, but to indifference, which in almost every case is far more difficult to overcome than opposition.

FIG. 5 A MILITARY TRACTOR OPERATING UNDER WATER

One other factor must be considered before a true picture of the conditions which prevailed prior to the installation of scientific management can be obtained. This is the method by which work was handled in the shop prior to and particularly during the war. Inasmuch as habits of work probably have a greater influence upon any attempt to make innovations in methods than any other one factor, an understanding of the situation in this respect is important. All things being equal, it is a fact that resistance is offered to a change *per se*, rather than to the effects of a change. This is proved by the objection of workers to changing back to old methods from new, after they had become thoroughly accustomed to the new methods, with the same strength that they formerly opposed the change from the old to the new.

Moreover, the force of workmen at the Holt plant was accustomed to certain methods of handling work. The proposed changes would necessitate their becoming accustomed to other methods. The old habits were strong and the forming of new ones would probably be accompanied with some inconvenience. This par-

ticularly applied to men of the grade of foremen and supervisors.

These individuals formerly were accustomed to planning work at the machine. They felt keenly that they were responsible for production, and that any removal of any part of their duties to another part of the organization, not only would be a reflection upon their ability, but also would result in decreased production for which they would be held responsible. They also felt that removal of any of the control exercised by them, would lessen their prestige among their men.

The Form of Organization

The form of organization which prevailed during the war comprised a number of separate departments, each more or less complete in itself, and having no responsibility to each other or to any individual excepting the general manager. This division of responsibility resulted in unbalanced production. The assignment of work to the individual mechanics was entirely in the hands of the several foremen, and these followed the lines of least resistance in discharging this portion of their duties. Difficult jobs or those requiring close attention on the part of the foreman were ignored as much as possible in the hope that they would fall eventually to the lot of someone else. Easy jobs were prolonged. The consequence of this procedure was that assemblies would be held up for the lack of one or more important parts, which upon investigation frequently were found not to have even been started. In some instances, it was even found that raw material was not on hand for these missing parts. In other cases it would be found that a shortage of parts would be reported, whereas the facts of the case would be that there was a surplus available but concealed somewhere in the plant by a foreman or workman for his own purposes and convenience regardless of others.

Failure to Co-ordinate Purchases

Closely allied to the above faults was an entire lack of co-ordination in the function of purchasing. Each of the several shop departments had authority to purchase for its own needs. Requisitions, of course, were made upon a central purchasing department, which placed the actual purchase orders. Attempts made by the purchasing department to ascertain whether or not similar items were on requisition from another department for the same purpose, or whether there were materials already in the plant which could be utilized could not be carried on with any great degree of success. A typical instance of the lack of co-ordination is the requisition of tools by the tool engineering department for the purpose of performing certain work which had been designed under its jurisdiction, and the requisition of exactly similar tools by the tool-room, either to replenish its stock or in anticipation of the need of these tools for the work just designed by the tool engineering department. This same failure to co-ordinate on purchases often worked in the opposite direction, and caused an actual shortage instead of a surplus of material. The authority for purchase being lodged in several places, the assumption frequently was made by the several departments that the requisition for a given lot of material had been made by one of the others. The consequence was that no requisition would be issued until the shortage would be made apparent by a lack of parts on assembly.

While some attempt had been made to keep a record of material on hand, it had not been under systematic control, and in operation under the conditions of war production became unreliable. This record was kept on cards and in the event of an argument in the shop, or for any other cause which seemed at the time good and sufficient, the card would be removed from the files and used as evidence in the case. At the conclusion of the argument, sometimes the card would be returned to its proper place in the file, but more often not. The question later arising as to whether or not there was any material of the kind represented by the card on hand, a reference to the file would show no record of such material ever having been purchased. There being no record, the natural assumption, therefore, was that there was no material available. A purchase order then might issue for the entire requirements of the shop for this particular material, and delivery being made it would be found that there already was a more than ample supply on hand.

The one function that was operating efficiently was Holt inspection. This probably was due to the fact that

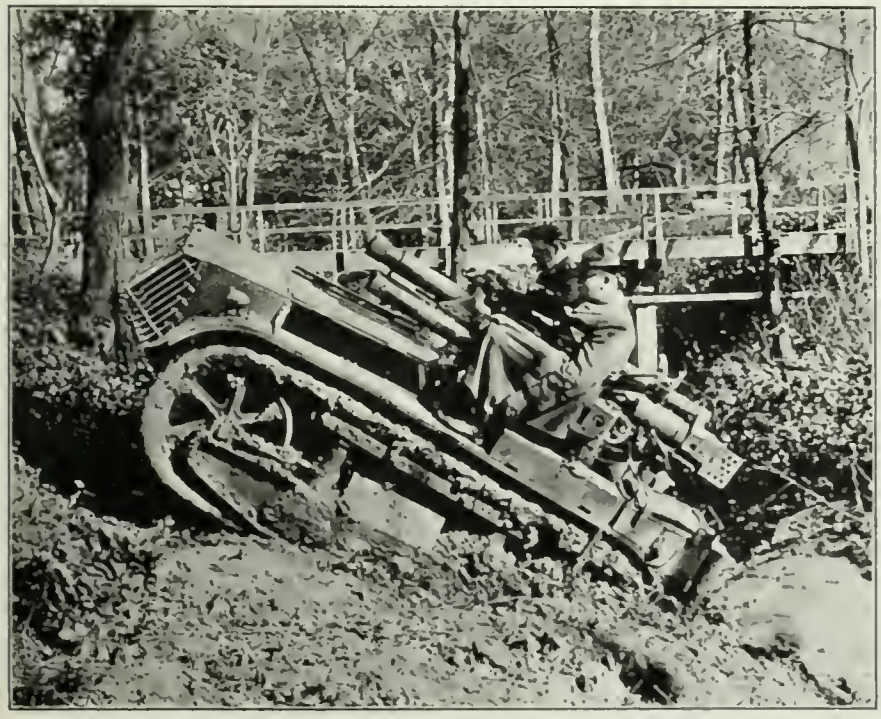


FIG. 6 MILITARY TRACTOR UNDER DIFFICULT CONDITIONS IN FRANCE
(Note the difference in general appearance from the industrial tractors in Figs. 1 to 3.)

inspection was really upon a competitive basis. The government had its force of inspectors in the shop, who passed upon the product after it had been passed by the Holt Company inspectors. Any rejection by government inspectors then was a direct reflection upon the ability of the Holt inspectors. It therefore was to the interest of the latter to catch all defective items before they reached the government inspectors. Inspection was made between operations, of finished pieces, of assemblies, and of finished tractors. The standards set were high and were rigidly maintained.

Such was the situation that existed at the beginning of the year 1919. Although the output of the plant was high, having averaged 12.6 tractors per day on three shifts during October 1918, this production had been obtained at high cost both in money, labor, and nervous energy and by a liberal use of parts made in other plants. The task set was to reconcile all the discordant elements and to bring the production under absolute control. In doing this it was essential that costs be brought down all along the line. This reduction of costs was not necessarily to be accomplished by an indiscriminate reduction of the cost of labor, but rather in the more efficient utilization of labor. Just how this problem was met and solved will form the subject matter of the succeeding article of this series.

(To be continued in the July issue.)

Grease Gun for Use With Cans or Barrels

Index Number
621.89 Lubricating device

THE accompanying photographs, Figs. 1 and 2, show a convenient method of utilizing original containers as part of a grease or heavy oil gun mechanism. The equipment can be made for any size of container in which grease is received, from a 5 lb. package to a 42 gal. barrel. The one illustrated here is designed for barrels.

The equipment consists of a truck, the container, a retaining strap, and a cover on which the gun is mounted. The truck runs on three wheels. One of these is larger than the others and is carried by a bearing attached to the truck handle, with which it turns, thus steering the truck. Two uprights on the angle-iron frame support the container. A slide running in each of these uprights carries a pin on which the barrel swivels.

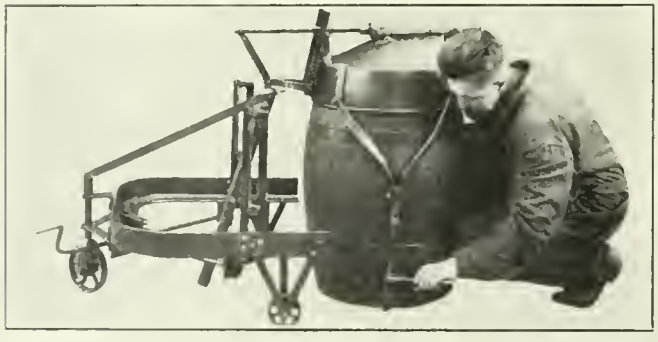


FIG. 1 ATTACHING THE GREASE GUN TO A BARREL

In order to make it easy to mount the barrel the slides are adjustable for height, the adjustment being accomplished by a screw on which each slide runs. The screws, in turn, are driven by bevel gears, shown beneath the truck, and operated by a small crank projection alongside of the front wheel. One drive gear is fastened directly on this crank, while the other receives its power by intermediate gears and shafting.

The sheet metal cover, put on after the barrel head is knocked out, carries two straps on each side, which are pivoted on a forging carrying a swivel pin. From the bottom of this forging a threaded rod projects, and this extends into the strap placed beneath the barrel. A nut draws this strap tightly against the barrel on each side, holding the cover in place and preventing any slipping of the barrel when mounted. The swivel pins carry heads or collars which fit into slots in the slides on the truck.

Mounting is done by one man as follows: After the cover is fastened to the barrel, the truck is backed against it, with the slides well below the swivel pin. By turning the crank the slides are elevated until the recesses, provided in their upper surfaces, engage the swivel pins. Further turning lifts the barrel several inches above the floor. It is then inverted and the grease flows down into the conical cover. A hose is attached to the gun nozzle to transmit the grease.

Working the lever back and forth drives grease or oil through the hose into lubricating cups, auto truck transmissions, reducing gears on machinery, and other places where required. As much as a pint per stroke is pumped. Control is accurate and grease cups can be filled without running over. In addition, the conical cover makes possible use of the entire contents. This device is handy, cheap to make, economical to operate, and is a large saver of time and materials.

FIG. 2 RAISING THE BARREL TO OPERATING POSITION

The Protection of Working Capital

Capital Requirements and Control—VII[1]

By J. H. BLISS

Comptroller, Libby, McNeill & Libby

Index Number
658.14 Financial control

AN appropriation of surplus for bond sinking fund reserves is frequently required by the trust deeds supporting bond issues. Most of these provide for the creation of a sinking fund to care for the retirement, or partial retirement, of the issue. As a general rule, these sinking funds are created by periodical deposits made with the trustee, and trust indentures commonly provide that as a deposit is made with the trustee for the sinking fund, a like amount shall be charged against the Income account or Profit and Loss account. The wisdom of this is obvious. The charge to the Income account is not made because such a charge is an expense of the year or a cost of doing business, but in order to protect the company from impairment of its working capital.

A going company will ordinarily receive new funds into the business from time to time through earnings left in the business, and only in this way. The payments to a sinking fund for retirement of long-term debts represent withdrawals of funds from the working capital of the business. In order to maintain the working capital it is therefore necessary to set aside a part of the new funds coming in each year through earnings, to cover the amounts which are withdrawn and deposited in sinking fund. Charges are not made against the Income account or Profit and Loss account of business covering sinking fund deposits with the thought in mind that such charges are in the nature of expenses, but solely to withhold sufficient of the earnings in the business to protect the working capital from impairment.

If earnings are not set aside to cover these withdrawals for sinking fund, the so-called Free Surplus account would appear that much larger and might result in disbursement of dividends in cash. Surplus cannot be considered if funds realized from these earnings have already been withdrawn from working capital and paid out of the business in retiring long-term debts.

Where the trust indenture does not provide for charges against Income, or Profit and Loss account, or Surplus account, covering sinking fund deposits, the concern should, of its own account, appropriate surplus to cover such withdrawals.

The necessity of this may not be apparent from the results of one year's business, but it should be borne in mind that the effects of these withdrawals for the sinking fund accumulate from year to year. While the amount taken out of the working capital in one year may not be of such importance, over a period of years these withdrawals might readily accumulate to a total equal to or exceeding the amount of the Surplus account. This is easily possible as bond issues may be of considerable size when judged in proportion to the total funds invested in the business; and the amounts withdrawn from working capital, accumulated throughout the years, might in time become greater than the amount which the company would ordinarily carry in its Surplus account.

The payment of dividends is the final test of corporate success and the only way in which the ordinary stockholder can benefit from his connection with the corporate business. There is, therefore, a strong and continuous pressure on the corporate authorities for dividends and the payment of improper or unwise dividends is frequent — usually through ignorance of the conditions. In the present article Mr. Bliss discusses this subject, pointing out how surplus may be protected, and these improper dividends avoided, by means of specific reservations from profits or free surplus.

As deposits are made in the sinking fund, a like amount of surplus should be appropriated and set up as a bond sinking fund reserve. This can be created by charges to Income account, or Profit and Loss, or Surplus account. When a bond is retired, the amount that has been set aside in the fund theoretically becomes free surplus—that is, at the disposition of the directors. As a matter of fact it generally is not free surplus, but more often surplus earnings which have been invested in fixed property and equipment. Bond issues are generally put out to finance plant and equipment investments. The retirement of such a bond issue out of earnings is in effect the investment of earnings in fixed plant and equipment properties. Hence this sinking fund reserve will generally represent surplus earnings left in the business but permanently tied up in fixed plant and equipment investments.

A sinking fund reserve cannot be considered as taking the place of a depreciation reserve, for to do so would result in understating the costs and operating expenses by leaving depreciation out of costs. Further, as a sinking fund reserve represents actual withdrawals out of working capital, any replacements which might be charged against that reserve if it were later transferred to a depreciation reserve, would represent a double drain on the working capital of the business.

[1] Preceding articles have appeared in MANAGEMENT AND ADMINISTRATION for December 1923, p. 705; January 1924, p. 25; February 1924, p. 155; March 1924, p. 299; April 1924, p. 405; May 1924, p. 529.

Therefore, the disposition of the sinking fund reserve, when the bond issue for which it was created has been retired, must take into consideration the future protection of the working capital position in the business. Such sinking fund reserves released by the retirement of the issue, are available for other purposes only in the measure that other permanent financing has replenished the working capital of the business. They should, therefore, be considered free surplus only when it is determined that funds are on hand as working capital to support them.

Surplus appropriated for bond sinking fund reserves is part of the net worth or stockholders' investment in the business, and should be included in the book value of the stock, as it represents earnings of past years which the stockholders have permitted to remain in the business in order to retire long-term debt. It is a part of the stockholders' investment the same as any other earnings or surplus left in the business.

Surplus Appropriated to Cover Expenditures for Fixed Properties

Expenditures are made from year to year for additions and betterments to fixed plant and equipment investments, and unless these expenditures are specifically provided for by permanent financing, they are withdrawals from working capital funds. In such case a like amount of surplus should be appropriated in order to withhold and keep up an equal amount of earnings in working capital. Such a Reserve or Appropriated Surplus account may be created by charges to the Profit and Loss account or Surplus account, setting the amount up as appropriated surplus.

As in the matter of surplus appropriated for sinking fund reserve, this may not be of importance in any one year, but it must be borne in mind that the effect of these withdrawals accumulates and builds up from year to year. The suggested practice is to appropriate at the close of each fiscal year an amount of surplus equal to the amount which is permanently invested in fixed plant and equipment out of the working capital funds. If such additions and betterments are later covered by permanent financing, such as bonds, and the proceeds of the bond issue are left in the working capital of the business, then the working capital has been replenished by this amount through the bond issue, and the Appropriated Surplus account may be adjusted accordingly, transferring a like amount back into the Free Surplus account.

Surplus appropriated to cover expenditures for fixed properties is a part of the net worth of the business and enters into the book value of its stock. It represents earnings which the stockholders have seen fit to leave in the business for the purpose of development in such direction as may seem advisable.

Surplus Appropriated to Cover Investments, Advances, and Securities

Where working capital funds of a business are permanently tied up in investments or advances to other companies, unless such investments are provided for by permanent financing, a like amount of surplus should be set aside in order to protect the working capital position of the business.

Investments in, or advances to, other companies very often mean current liabilities have been created, and it must be recognized that such current liabilities cannot be liquidated out of these permanent investments in, or advances to, other companies. If not covered by permanent financing, the funds of necessity must come out of working capital. Hence to protect the working capital position of the company, surplus should be appropriated to such an amount as will withhold a like amount of earnings in the business.

Surplus Appropriated to Cover Intangible Fixed Investments

Intangible fixed investments made by expenditures of working capital funds, unless provided for by permanent financing, should be covered by appropriations of surplus in order to protect the company's working capital position. Expenses in connection with patents, franchises, copyrights, advertising, etc., when capitalized, represent expenditures of current working capital funds which usually are not specifically provided for. These are permanent investments, the same as investments in plant and equipment. They represent investments of surplus earnings. Whenever important they should be covered by appropriation of surplus in order that a like amount of funds may be retained in working capital.

These appropriations to cover intangible fixed investments represent a part of the net worth or stockholders' investment in the business and should be included in computing the book value of the stock. If these intangible investments are later amortized or written off against the operations, the amounts so charged off represent sums withheld in the business, and build up the working capital. Hence, as these intangible fixed investments are written off, it would be logical to release the surplus which was appropriated to cover them to the amount of the write-offs.

Surplus Appropriated to Cover Deferred Charges

Deferred charges arising out of bond discount and expenses do not represent withdrawals from the working capital of the business as they are covered by the bond issue.

The amortization of debt discount and expenses from year to year throughout the life of a bond issue is in itself a protection to the working capital of the business and ultimately withholds in working capital the amount of such discount and expense which is to be disbursed as the bonds are retired.

On the other hand, deferred charges arising out of expenditures of working capital funds, for instance such as: organization expenses (other than paid in stock); experimental expenses; development expenses; cost saving expenses; advertising expenses; obsolescence deferred; extraordinary expenses, and losses, should be regarded as investments of surplus earnings left in the business and like amounts appropriated from surplus wherever the sums are of importance. Such expenses as these almost always mean that current liabilities have

been created, and it must be realized that current liabilities cannot be liquidated out of deferred charges such as these.

As such deferred charges are amortized or written off into the expenses, like amounts of working capital are withheld in the business, and it would be in order to release a similar amount from any surplus appropriated to cover. Surplus appropriated to cover deferred charges represents a part of the net worth of the business and should be included in computing the stockholders' investment.

Surplus arising out of revaluation of properties may mean either:

1. Surplus created by reinstatement of values previously written off.
2. Surplus arising out of enhancement in values of properties.

In the first case, where the revaluation is the reinstatement of values previously written off through excessive depreciation or writing off of replacements, additions, and betterments, etc., the surplus arising from such a revaluation may be free surplus in that the writing off of values in previous periods withheld working capital funds in the business.

On the other hand, these revaluations will usually represent the accumulation of years and may be very large in proportion to the Surplus account carried by the company. Considering such an adjustment free surplus, distribution in the form of cash dividends might mean serious impairment of the working capital of the company. It is more likely that surplus arising from such revaluation will really represent surplus earnings invested in fixed properties which should not be considered free surplus, except as such additions to fixed properties are permanently financed.

Surplus arising out of revaluation which simply recognizes enhancement in values of properties or higher replacement values, is not free surplus in any sense of the words. It is simply capital surplus and should be treated in such a manner as to insure the business against withdrawals of working capital funds through it.

Any surplus arising out of revaluation of fixed properties is a part of the net worth or stockholders' investment, and should be included in the net worth section of the balance sheet, being stated here as appropriated or invested surplus, as the case may be.

Surplus Arising Out of Revaluation of Other Fixed Investments

Surplus arising out of revaluation of other fixed investments might include revaluation of intangible fixed investments, revaluation of permanent investments in securities, or stocks of other companies. Surplus created by revaluation of intangible fixed investments must not be considered free surplus; it is capital surplus and the working capital of the business should be protected from possible withdrawals through it.

The revaluation of investments in other companies may arise through revaluation of properties and investments of the subsidiaries or affiliated companies. Such surplus is to the holding company the same character of an item as it is to the subsidiary company. Revaluation of properties of a subsidiary company, resulting in a surplus credit, will affect and increase the investment carried by the holding company. While such surplus is almost always capital surplus, it may be appropriated to extinguish any good-will element which appears in the holding company's investment in such subsidiary, especially that portion of the revaluation which may be allocated to years prior to the purchase of the control in such subsidiary company.

Surplus Arising Out of Premiums on Capital Stock

Where capital stock is sold at a price in excess of its par value, the premium above the par value represents paid-in surplus. It is a part of the stockholders' investment in the same degree that the par value represents stockholders' investment.

Premiums on capital stock differ from premiums on bonds in that the premium on stock is a permanent investment of the stockholders and it is capital surplus paid in. The premium received on bonds is an adjustment of the interest which the business is to pay for the use of such borrowed funds and, as such, should be written off over the period of the bond issue. Surplus arising out of premiums on stock should be set out separately as paid-in surplus or capital surplus.

Dividends may not properly be paid out of surplus arising out of premiums on capital stock, for that would result in an impairment of the stockholders' original investment.

Surplus arising out of premiums on capital stock is a part of the net worth or stockholders' investment, and should be included in computing the book value of the stock.

Such surplus should not be considered as taking the place of a reserve for bond retirement, or an appropriation to cover investments in fixed properties, or any other appropriation from surplus to cover permanent investments made out of the working capital funds.

Surplus Arising Out of Donated Treasury Stock

Where stock once issued and outstanding is donated back to the company for the purpose of resale, to supply added working capital or other capital necessary to the business, a donated or capital surplus item is created. The amount of donated surplus is the sum which is realized on the resale of the donated treasury stock. Such donated treasury stock is usually sold at a figure somewhat different from par. If donated surplus is written into the accounts, as the stock is received, to the amount of the par value of the stock, then any discount suffered upon the resale of the stock must be considered as an offset against this Donated Surplus account. The amount which the company receives is the net amount ultimately realized on the resale of such stock.

If donated treasury stock is to be promptly disposed of and the approximate price which it will realize can be determined, there would be considerable justification for entering it into the accounts as a charge to treasury stock and a credit to surplus arising out of

the donated treasury stock, at such prices. In such case later, when the stock is finally sold, any minor adjustments necessary may be made in the Donated Surplus account.

If the immediate purpose of the donation is to create a Surplus account and avoid the necessity of showing a deficit or impairment of capital, several questions arise for consideration, among them:

1. Valuation to be placed on the stock.
2. Treatment of such surplus.
3. Statement of the treasury stock in balance sheet.

Presumably such donated stock will be valued at par on the ground that it is in effect a reduction in the outstanding capital to the amount of its par value, and credit will therefore be taken in surplus for an equal amount.

Such an adjustment, of course, has no effect on the net worth of the company, or the amount of that class of stockholders' investment in the business, but it does enhance the book value of the outstanding shares. The investment supporting this class of stock issues in total remains unchanged. There is less stock, but the Surplus account has been increased by the same amount. The only effect is to raise the average investment per share, thus increasing the book value of each outstanding share of that class. Surplus arising out of such capital stock donations is purely capital surplus. It should not be confused with earned surplus.

In stating a balance sheet, donated treasury stock entered at par values, must be considered as a reduction in the outstanding capital stock. It is treasury stock only in the sense that it is not outstanding. It is not an investment of the business, but simply a reduction in the amount of outstanding stock. To treat such donated treasury stock as an asset or investment, would inflate the net worth of the business as shown by its balance sheet by the amount of such donated surplus. This is not the effect of the transaction. The transaction does not increase the net worth of the business—it simply adjusts the accounts representing that worth as between capital and surplus.

If, in after periods, donated treasury stock is again sold, the proceeds represent increased stockholders' investments, and increase the net worth of the business. The amount of such increase in the net worth or stockholders' investment is the proceeds from the sale of the stock, and if it is sold at less than par value, the discount must be considered an adjustment of the capital surplus arising out of the stock donation.

Surplus Arising Out of Sale of Fixed Property Investments

Surplus arising out of the sale of fixed property investments is usually considered capital surplus as resulting from gains or profits other than those earned in the ordinary course of business. In this sense it is capital surplus, but if the funds represented by this surplus are left in the working capital of the business, such profits finally realized are in reality as much free surplus as any other earnings finally realized and left in the business. It may be better, as a matter of policy, in handling such surplus in any certain circumstance, to consider it working capital surplus, not because of the character of the item, but rather because of other circumstances, particularly the working capital position of the business.

Such surplus is in reality the result of capital profits as distinguished from profits arising out of earnings realized in the ordinary course of business. Cash dividend disbursements out of such capital profits should be distinguished as extraordinary dividend distributions. Stock dividends declared out of such surplus should be made only after consideration of the added permanent financial burdens which are placed on the future operations of the business.

Insurance Reserves

Some business organizations, having widely distributed properties, carry some of their own insurance risks for the reason that the cost of insurance of properties in outside insurance companies would amount to more than any possible loss at any one place. The wisdom of this depends entirely on the class of business, how the properties are distributed, and what the possible loss in any one risk might be.

There is little to be said in a general way about the advisability of a concern carrying its own insurance, for that is a matter dependent entirely upon local conditions. Obviously the firm should carry its own insurance only on preferred risks. This is merely a matter of conservatism. Hazardous risks, either because of the type of property or operations conducted therein, or because of adjacent properties or operations, are generally much better covered by outside insurance.

Where an organization assumes some of its own insurance risks, it should include in its expenses and costs of operation a charge for insurance at the regular rates which would prevail if the risks were carried by outside insurance companies, setting up this amount as an insurance reserve against possible future losses. This is desirable, not only from the point of view of figuring costs on a competitive basis, but also to provide a reserve to absorb any losses which may occur.

Setting up an insurance reserve, however, performs only a part of the function of insurance carried in outside companies. It does protect the Surplus account of the company against losses, but does not furnish the ready capital to cover the loss as would be the case with the outside insurance company. Hence, there is also to be considered the matter of insurance funds to support the insurance reserves and to provide necessary liquid capital to cover losses in case they occur. This would contemplate paying out of the working capital the insurance premiums that would be paid to an outside company, and setting these premiums aside in a fund and investing them in readily realizable securities, so that in case of a loss the concern is protected, not only as to Surplus account, but as to its working capital as well.

A method by which this may be accomplished is to create an investment fund and set up an Insurance Reserve account. The amount of regular insurance premiums would then be set aside in the fund each period and a like amount set up in the reserves by

charging expenses. Such a fund and Reserve account would operate along lines similar to the bond sinking fund and Bond Sinking Fund Reserve account.

Earnings on the insurance fund investments might also be considered as accretions to the fund and credited to the Reserve account. In this manner the cost of operations of the company would include insurance charges on the same basis as if insurance were carried in outside companies, and the organization would be building up a fund to protect its working capital and a reserve to protect its surplus against possible loss.

After such a reserve fund has been in operation for a period of years, if losses have been few, the fund and reserve will build up to a point sufficient to cover possible losses, and there will be an element of profit. The amounts which should be carried from time to time will depend upon local conditions but should not be reduced below the amount of reserve which an insurance company would be required to carry under similar circumstances.

Insurance reserves are a part of the net worth of the business for they would accrue to the benefit of the stockholders in case of liquidation. There is no obligation to provide out of profits for contingencies that may occur in the future. Such reserves are voluntary and an evidence of conservatism, and represent a part of the net worth of the business.

Reserves Against Decline in Inventory Prices

Reserves against decline in inventory prices are contingent reserves in the sense that there may be no obligation to provide against losses which may possibly be incurred in the future. If the price declines have already occurred, obviously they should be recognized on the basis used in stating the inventory. These reserves should cover only possible future losses due to declines in prices. The wisdom of providing reserves for such losses is now painfully apparent. We can all look back over the past few years and readily realize that the profits of war years were in a substantial measure the result of inflation. We know now that these profits should not have been considered as finally realized profits. The losses sustained as prices fell were simply the relinquishment of some of the profits that were recorded during the periods of inflation, and in this sense may be considered as an offset against these profits.

Reserves against decline in inventory prices should generally be created out of surplus for the reason that the profits which they are intended to offset were realized in previous years, and were passed into the Surplus account. These reserves should not be considered as a deduction from the inventory values in the current assets section of the balance sheet, as it is presumed that inventories have been valued on a conservative basis, cost or market, whichever is lower. They therefore represent a part of the *present* net worth of the organization.

The advisability of providing for such contingencies is emphasized by the fact that so-called inventory losses are working capital losses. They come directly out of the working capital of the business. Ample provisions should be made against such possible losses in order that the working capital of the company may not be impaired as it would if such losses were incurred and no reservation of surplus had been made.

Reserves for Contingencies

Any other reserves for contingencies which are provided for voluntarily to protect the company against possible losses occurring in the future, represent a part of the present net worth or general surplus of the company.

While there may be no obligation to provide out of present profits for future contingencies, the advisability of a conservative policy in this connection should not be questioned. It is especially desirable when we consider such reserves for contingencies as a part of the general surplus of the business, merely setting it aside to protect the company against expenditures out of surplus earnings which might result in an impaired working capital position if these contingencies are realized.

Contingency reserves as here mentioned are not intended to cover necessary reserves—such as for depreciation, depletion, bad debts, the reduction of inventory values to market, losses and expenses incurred but not accurately determinable in money value. Nor, on the other hand, should they be taken to cover voluntary reserves set up—such as insurance reserves, earnings invested in fixed properties, earnings otherwise permanently invested, bond sinking fund reserves. For it must be borne in mind that if any of these reserves are necessary to protect the working capital position of the company against further withdrawals through Surplus account, then these reserves cannot be considered available to meet other contingencies, for this might mean a double withdrawal.

Open Undervaluation of Assets

To overvalue, knowingly, the profits, or overstate the financial position of a business, is a practice which cannot be too severely condemned. This proposition is universally recognized among business men and accountants.

The opposite proposition, undervaluation of profits or understatement of the financial position of a business, occurs occasionally. Such understatement of financial position of a business may be accomplished in a manner apparent on the face of the balance sheet or by methods not disclosed on the face of the financial statement, which would not, in this latter case, indicate the understatement of financial position.

An open understatement of the financial position of a company is usually found in an undervaluation of known assets, such as the carrying of good-will, patents, franchises, etc., at no value or at a nominal value, or carrying furniture and fixtures and other tangible assets at $1 or other nominal value. Also, an overstatement of reserves might be apparent on the balance sheet. Carrying investments at value which are under market, and indicating market values on the face of the balance sheet, etc., also indicates an understatement, but one of a very open nature.

While it may be said in a general way that the

balance sheet should reflect a full and true valuation of the assets and liabilities and net worth of a concern, such open understatements cannot be condemned, as they usually represent prudent foresight and conservative policies, the benefits of which are to the corporation and its stockholders beyond question.

Concealed Undervaluation of Assets

On the other hand, a concealed understatement of financial condition should be given careful consideration. These understatements are generally termed secret reserves and may take several forms, such as writing down of valuable assets to a small figure, providing excessive depreciation, depletion, bad debt or contingency reserves, valuing of inventories at much less than cost or market, or including special or excessive reserves for contingencies among liabilities. As many industrial organizations do not publish income statements showing their gross earnings, such reserves may readily be made in such form as not to be apparent in any way in the published accounts, and therefore would be known only to the officers and directors familiar with the details of the business.

While in a general way the creation of secret reserves may be condemned, each case must be judged on its own merits, and such judgment will oftentimes depend upon the motives underlying the creation of such reserves.

Arthur Lowes Dickinson writes in "Accounting Practice and Procedure":

> Where the directors or managers have exercised wise discretion in providing in advance for contingent losses incident to the nature of the business, which cannot from a reasonable point of view be considered in excess of the amount which a wise foresight would provide, it would seem that no exception should be taken to the undisclosed provision thereof. This would apply particularly to cases in which the business conducted was of a fluctuating or speculative character, or in which its success was largely dependent on the maintenance of very high credit, such as a bank. . . . In all such cases the sudden disclosures of heavy deficits or losses, which are clearly incident to the nature of the business but only occur at irregular intervals, may easily be disastrous to the interests of the stockholders by unduly depressing the market price of the capital stock, and it would seem to be not only the right but the duty of directors to protect them against such contingencies by making ample secret reserves when profits permit. Where, however, reserves are made largely in excess of any possible contingencies, the amounts provided should be disclosed in the Profit and Loss account and probably also in the balance sheet so that all those interested may be in a position to form a reasonably correct opinion as to the financial position.

This was written before 1914. In the light of happenings of the last six or eight years, the reasonableness and sound business policy of this quotation cannot be questioned. It is true that the creation of secret reserves through improper motives, such as the desire to freeze out minority stockholders, must be condemned. Further, the creation of excessive secret reserves cannot be considered other than improper, but beyond this it is a responsibility of the directors and executives of an organization to protect the interests of the stockholders of their organization. If they, who are in a position to know the most about the affairs of a business, realize the uncertainty of the future, and in good faith provide against possible contingencies which would affect the interest of their stockholders unfavorably, it seems they would have only done their duty. The best interest of a stockholder is found in a stable investment unaffected by unwarranted speculation or extraordinary losses.

Many industries are subject to periods of unfavorable business and practically every business in the last few years has been affected to a greater or less degree by war-time and reconstruction conditions. A policy, the purpose of which is to protect the best interest of the stockholders, assuring the stability of their investment, and the continuance of the business in good financial condition, should be commended. This, however, is not to be taken as an excuse for secret reserves where these are made for fraudulent purposes.

Borrowing Funds to Pay Dividends

From the legal point of view there can be no objections to borrowing funds for the purpose of paying dividends if the dividend is a legal one. It often happens that the concern has made ample profits, but at the time a dividend payment is to be made does not have the liquid funds to spare.

The question is often one of the determination of free surplus. If earnings of a company have been tied up in permanent investments, as plant and equipment and other fixed investments, while there may be ample surplus for the payment of dividends, such a disbursement might mean a double withdrawal out of the working capital funds of the business.

Borrowing on short terms to pay such dividends does not improve the conditions, for had the working capital in the business been properly protected through financing to cover permanent investments in plant and other fixed assets, or surplus earnings appropriated to cover these investments, there would have been on hand ample working capital to meet the dividend requirements.

Nor is the payment of these dividends in scrip, as is sometimes done, always satisfactory. Usually such issuance is due to the fact that the company has tied up its earnings in permanent investments, or in the retirement of long-term liabilities, or perhaps it may be due to expansion with the result that the funds have been used or are needed in the business.

The scrip then ordinarily takes the form of a short-term promise to pay and in such case is only the substitution of scrip liability for a dividend liability—a change in form but not in effect. The expediency of such a substitution must, of course, be judged in the light of the conditions. Unless some new financing is contemplated, or funds will be released in some way, to provide for the scrip redemption, its issuance would seem of doubtful wisdom.

It must be realized that earnings cannot be used to construct buildings and still be available for use in distribution of cash dividends. Current borrowing to pay dividends, except such borrowings as are necessary because of purely temporary conditions, are not a solution of the difficulty.

The Mechanics of Profit-Making

By PARK MATHEWSON

Vice-President, Bankers Development Corporation

Index Number
658.14 Financial control

THE function of the official in charge of a company's finances—who is usually its controller or occupying a similar position—is to guide its financial policies along lines which will return the greatest profits to the business. This is, of course, the final objective of every department head, but the finance manager's particular aim is to obtain a broad view of the whole situation and so to co-ordinate the various methods and policies of the different departments as to produce the desired results. That is, the manager of finance is a stabilizer and co-ordinator. He cannot be a dictator of policies—that function can only be exercised by the president or chairman of the board—but he must see that the official who does exercise this function understands the full consequences of every important step which bears upon the future progress of the company.

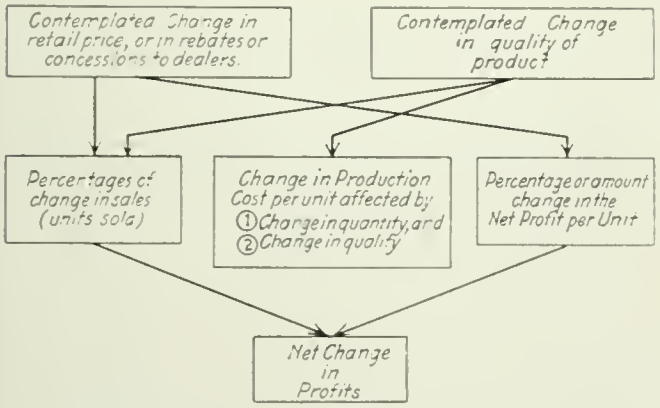

Contemplated Change in retail price, or in rebates or concessions to dealers.
Contemplated Change in quality of product
Percentages of change in sales (units sold)
Change in Production Cost per unit affected by ①Change in quantity, and ②Change in quality
Percentage or amount change in the Net Profit per Unit
Net Change in Profits

FIG. 1 THE PRICE-QUALITY PROBLEM

Arrows indicate the course of the analysis which should be followed in deciding upon changes in price or quality.

For example, often during prosperous periods, policies are mainly influenced by the sales department, and selling enthusiasm is apt to outrun sound business judgment. In times of depression, on the other hand, drastic cuts in overhead and severe contractions of programs frequently "cramp the style" of the sales department and completely thwart previous creative efforts.

Before any definite changes or new policies are decided upon, the results should be considered from every point of view. It is usually found that no important shifting of plans in one department can be made without affecting other departments and other phases of operation, for all are interrelated. It, therefore, becomes vital to study the logical sequence and outcome of any such proposed changes.

A graphic plan of analyzing the effect of proposed changes is outlined in the following text and its accompanying charts. This plan may be adapted to any business. Its purpose is to show and emphasize the logical relations between departments and the various factors that must be taken into account in estimating future operations and profits.

The "mechanics of profit-making" resolves itself into three phases: 1. Sales. 2. Production. 3. Administration, finance, and growth.

The sales problem (which comes before production in planning budgetary control), has two subdivisions. (a) the price-quality problem; and (b), the sales-effort problem.

The "production problem" means, primarily, the analysis of operating efficiency and cost of production or purchasing.

The problem of administration, finance, and growth has two aspects, first as related to internal factors and second with regard to external conditions. Internal factors include sales efficiency, production efficiency, and administrative (including finance management) efficiency. Vital external factors are the shortage or surplus of labor, capital, materials, and transportation, as well as the buying power of the public and the effects of competition. The external factors are largely affected by economic cycles, and their changes tend to complicate the normal problems attending the natural growth of a business enterprise.

The figures listed below picture these problems in their relation to the mechanics of profit-making.

Fig. 1. The Price-Quality Problem.
Fig. 2. The Sales-Effort Problem.
Fig. 3. The Cost-Production Problem.
Fig. 4. Finance Management and Business Growth.
Fig. 5. Finance Management and the Economic Cycle.

The Price-Quality Problem

Fig. 1 analyzes the effects which should be expected to follow any contemplated reduction or increase in the price of a product or "line". Of course when a considerable variety of products is made and distributed, and price changes are made in one product and not in others, production costs for each article are figured separately. The chart is based on the assumption that a comprehensive change in price schedule, which would have a considerable effect upon the company's plans and operations, is to take place.

It is not always fully appreciated that a change in the quality of goods is practically equivalent to a change in price. For example, in the sale of men's overcoats and suits the omission of a fancy lining or of special workmanship is equivalent to a raise in price

This brings up a problem in buying psychology. Will the public fail to note the change in quality and buy more largely than if price (rather than quality) had been changed? Or will they resent the cheapening of the product and purchase elsewhere? Will one factor offset the other, or what will be the net result? No attempt, of course, to answer this problem, i. e., the alternative of change in price or change in quality—has been made in the chart, but it must be kept in mind when changes are contemplated in the sales policy.

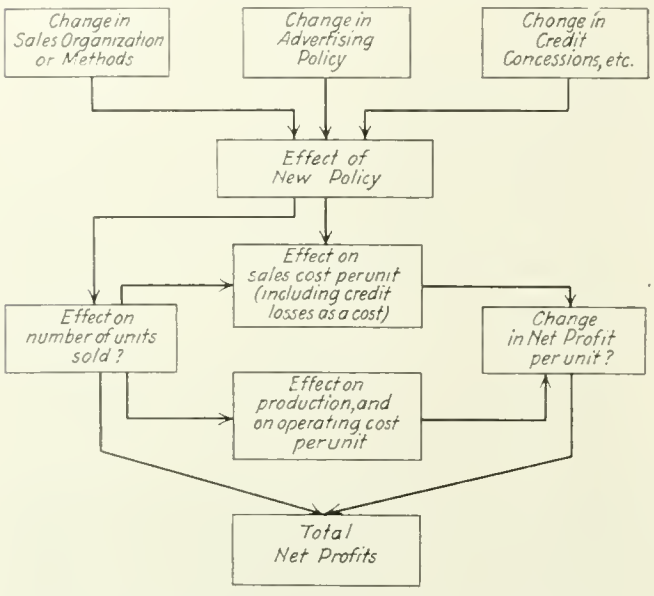

Change in Sales Organization or Methods
Change in Advertising Policy
Change in Credit Concessions, etc.
Effect of New Policy
Effect on sales cost per unit (including credit losses as a cost)
Effect on number of units sold?
Change in Net Profit per unit?
Effect on production, and on operating cost per unit
Total Net Profits

FIG. 2 THE SALES-EFFORT PROBLEM
Arrows indicate the course of the analysis which should be followed in deciding upon changes in sales policy.

As indicated in the chart, a change in either price or quality will normally affect the amount of goods sold. (We are assuming a case of competitive sales, where there is no monopoly of the product). A change in the amount of goods sold will also effect the production problem: if a larger amount is produced the unit cost both for production and sales should usually decline somewhat, due to the natural economies in larger operations. A change in quality should also have an additional effect on operating methods and hence on the production cost.

Having estimated (1) the extent to which sales (in units, not dollars) will be affected, (2) the change in price if any, and (3) the change in the production (or purchasing) sales cost per unit resulting from the new policy, the combination of these three estimates will indicate the net change in profits. This estimate having been worked out, the advantage or disadvantage of making the proposed change will be evident.

The Sales-Effort Problem

Fig. 2 analyzes changes in selling policy other than a change in the retail price or the quality of the goods. The two normal methods of increasing sales are (1) a change in the sales department organization or methods, and (2) a change in the general advertising policy. Here again the finance manager must seek to determine from past experience what effect the proposed change will have on the amount of units sold, which in turn affects (a) sales, and (b) production costs per unit and *total profits*.

The Cost-Production Problem

Fig. 3 deals with questions relating to production and cost policies. A change in production methods, such as the installation of new machinery, running of an extra shift, or a change in the production schedule, may be contemplated. To what extent will this change reduce or increase the wage cost per unit on the one hand, and increase or diminish the overhead charges for rent, interest, etc., on the other hand? A careful analysis by the finance manager must be made to determine whether the gain in one field of expense will more than offset the loss in the other department. The problem may be affected in many cases by the difficulty of separating the cost (including the allotment of overhead) for the various departments and products. No attempt has been made to include this problem in the chart, as it is difficult to indicate in a chart the line of analysis which should be followed in solving this problem.

Finance Management and Business Growth

Fig. 4 covers the problem of the normal growth of a business in its most general aspect. The influences which govern the advancing success and development of the enterprise may be divided naturally into internal and external factors. The internal are (1) production efficiency, (2) sales efficiency, (3) the finance

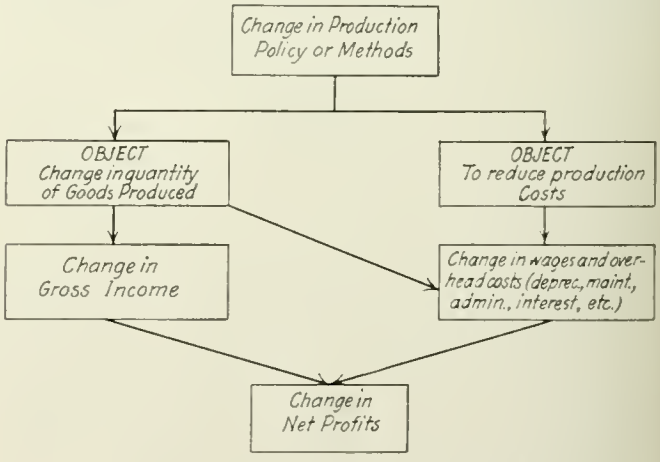

Change in Production Policy or Methods
OBJECT Change in quantity of Goods Produced
OBJECT To reduce production Costs
Change in Gross Income
Change in wages and overhead costs (deprec., maint., admin., interest, etc.)
Change in Net Profits

FIG. 3 THE COST-PRODUCTION PROBLEM
Arrows indicate the method of analysis to be followed.

management, and (4) administrative efficiency. The latter not only affects the growth of its functions but also the business as a whole through its control of financial policies. The production and sales results will, of course, be reflected in the future growth of business.

On the other side of the picture, there are the external factors which each company can control only to a very small degree, but which it must be prepared to foresee and cope with as they are encountered. The external factors center in the economic cycle, i. e., the

recurring ups and downs of business prosperity with which all business men are familiar. On the one hand the state of present or future depression or prosperity affects the company's supply of capital, labor, raw materials, and transportation facilities. In depression all of these necessities of production may be freely available, but as the country emerges from depression and enters a period of prosperity one after the other of these four factors will become scarcer and scarcer. Eventually the supply of one or more may be almost completely exhausted and the problem of acquiring additional supplies will perhaps form the chief temporary problem of the executive. This scarcity will be what economists call the "limiting factor" in production, or in more ordinary language the "neck of the bottle" in the company's schedule.

On the other hand, the economic cycle affects the public buying power through the medium of decreased or increased wages, the general psychology of spending, etc. Competition will also be directly affected. During depression competition will be keener, and price-cutting and concessions are likely to be practiced. This chart analysis should help the finance manager to recommend appropriate policies to meet the problems brought up by each emergency.

Finance Management and the Economic Cycle

Fig. 5 undertakes to analyze in greater detail the general effect of the economic cycle. In this chart the various phases and policies of a business enterprise during depression and prosperity are analyzed. The alternative policies are designated in each case as (1) conservative or moderate, (2) normal or average, and

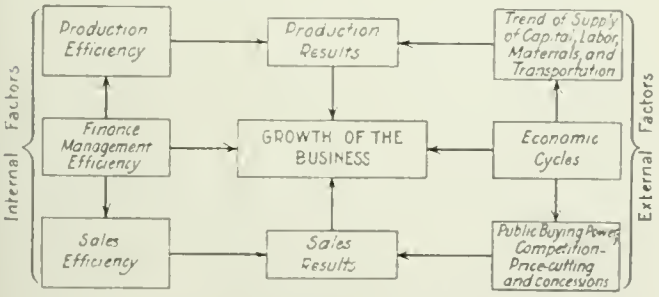


FIG. 4 FINANCE MANAGEMENT AND BUSINESS GROWTH

(3) radical or unwise. Of the three policies indicated on the chart the conservative or moderate policy usually yields the best results in the long run.

The Economic Cycle

A great deal of discussion has appeared from time to time with regard to the economic cycle. Business in general has tried to escape its vicious circle of rising prices, wages, and money rates followed by a sudden decline in buying power and profits. It has been advocated in high quarters that the expenditures of the federal and state governments and municipalities for public buildings and works be regulated so as to relieve unemployment during periods of depression, and not bring about undue competition for labor during periods of prosperity. This policy if it were generally followed would have the effect of helping to reduce the violent fluctuations to which business is subject, but would not entirely eliminate such swings, first, because they are a world-wide phenomenon, and second, because they are largely a result of "mass psychology" and are avoidable only to the extent that human nature can be made over. If as has been proved, many hard-headed business men buy when prices are high and sell when they are low, what can be expected of the average citizen? Hence it is all the more essential that popular education as to the real nature of the economic cycle should be continued.

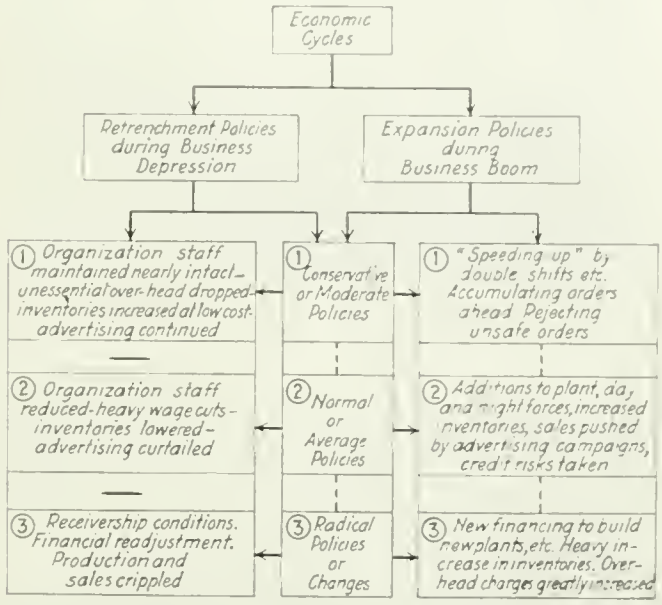

Economic Cycles
Retrenchment Policies during Business Depression
Expansion Policies during Business Boom
(1) Organization staff maintained nearly intact—unessential overhead dropped—inventories increased at low cost—advertising continued
(2) Organization staff reduced—heavy wage cuts—inventories lowered—advertising curtailed
(3) Receivership conditions. Financial readjustment. Production and sales crippled
(1) Conservative or Moderate Policies
(2) Normal or Average Policies
(3) Radical Policies or Changes
(1) "Speeding up" by double shifts etc. Accumulating orders ahead. Rejecting unsafe orders
(2) Additions to plant, etc., and night forces, increased inventories, sales pushed by advertising campaigns, credit risks taken
(3) New financing to build new plants, etc. Heavy increase in inventories. Overhead charges greatly increased

FIG. 5 FINANCE MANAGEMENT AND THE ECONOMIC CYCLE

The chart indicates the inevitable result of poor business judgment during a period of prosperity, sometimes resulting in bankruptcy and receivership during the subsequent depression. Immense losses have resulted to the holders of securities, which are at least partly due to the fact that these holders have neglected to interest themselves in the affairs of the corporation and veto unwise policies of the officers. Receivership usually comes with little warning, frequently being brought about by petition of banking or merchandise creditors. After receivership is declared the security-holders organize—too late except to salvage what remains out of the wreck.

Fig. 5 should, therefore, interest security-holders of the company, as well as its executive head, not only because economic cycles cause wide swings in speculative stock prices, but also because they directly affect the security of the great majority of investment stocks and bonds. The interests of the security-holders of an enterprise should be an especial care of the really capable finance manager, first, because, obviously, anything that affects their interests adversely must also affect the real interests of the corporation adversely, and, secondly, because their satisfaction or dissatisfaction will affect their future attitude toward any further financing of the company. Security-holders, though often called upon to do so, are naturally averse to following up bad money with good

Eight-Wheel Motor Truck Develops from Eight-Wheel Bus

Index Number
658.281 Motor trucks

WHAT is claimed to be the first eight-wheel automobile in the world is shown in the accompanying photographs. It steers on all four front wheels, and drives on all four rear wheels.

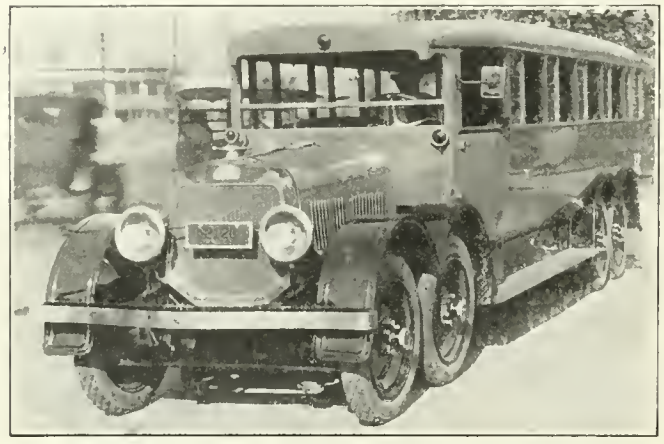


FIG. 1 ORIGINAL EIGHT-WHEEL MOTOR BUS

If one axle at either end is broken the other will maintain the car in service until a new one is supplied, and eliminate the danger of accidents due to broken axles. If a front tire blows out the machine still has three front tires on which to steer instead of only one as would be the case with a four-wheel car. Figs. 1 and 2 show views of the machine.

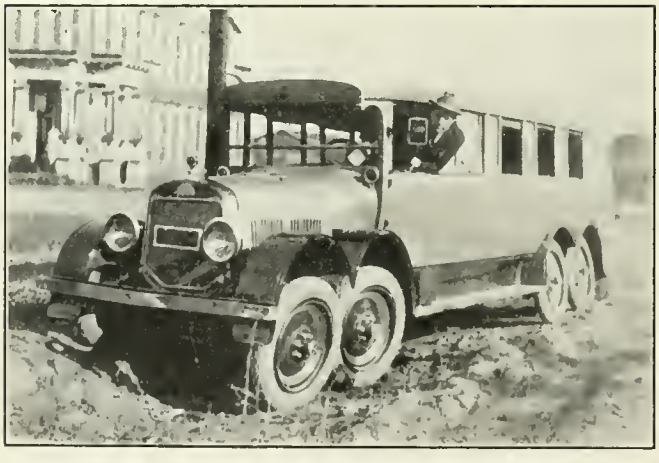


FIG. 2 UNEVEN GROUND IS TRAVERSED WITH ONLY SLIGHT VIBRATION

While operating at 25 miles an hr. on slippery pavement the driver tried to skid the machine by throwing the clutch out and putting on all brakes. But the machine did not skid, showing that another danger of the four-wheel car is greatly reduced by the use of eight wheels.

When traveling at 48 miles an hr. the eight-wheel car was driven around a curve, but the swaying of the body was not perceptible, because of the special features embodied in the chassis and the special spring suspension. By employing eight wheels, it was possible to use smaller wheels, lowering the center of gravity of the bus and its load, and eliminating a great deal of the danger of instability.

In passing over a series of railroad tracks at rapid speed the machine undergoes no great shock. In fact, passengers feel only a flutter, due to the spring suspension, and due to striking on eight points instead of four.

On account of the great success of the eight-wheel bus the inventor was led to build an eight-wheel motor truck, shown in Figs. 3 and 4. This truck carries a load of nine tons and tows a trailer or trailers carrying 11 tons, which altogether amounts to a carload of many kinds of commodities. It does this without difficulty at a sustained speed of 35 miles an hr.

Experts who have seen this eight-wheel truck in operation claim that it has many advantages over the four-wheel truck for rapid transportation of large loads of perishable goods such as fresh milk and ripe fruit. The extremely flexible axle hanging of both front and rear sets of wheels eliminates three-quarters of the road shock. The milk is not churned nor the fruit bruised. Fragile articles such as glass, pottery, furniture, and a large class of other manufactured goods likewise are carried without injury.

FIG. 3 EIGHT-WHEEL TRUCK BUILT AS A RESULT OF THE SUCCESSFUL OPERATION OF THE MOTOR BUS

While the cost of four additional tires is a factor to be considered, this is offset by the ability of the truck to carry about double the load of an ordinary truck.

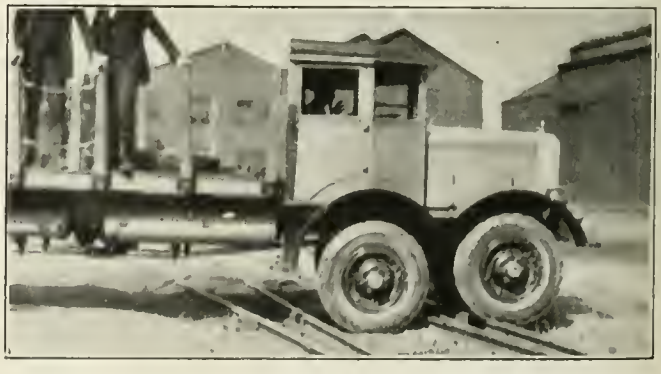


FIG. 4 SHOCKS FROM RUNNING OVER RAILROAD TRACKS ARE MINIMIZED

The Power Supply of Southern Industry

The Piedmont Section of the Carolinas—II[1]

By RALPH G. MACY

Consulting Mechanical and Electrical Engineer

ONE of the main factors that is responsible for the rapid industrial growth of the Piedmont section is the opportunity afforded the textile mills, furniture and tobacco factories, and the miscellaneous plants to secure cheap power. As this power could be purchased by the individual plants cheaper than it could be generated, the capital required for power generating equipment was made available for plant expansion. The location of the mills and factories and the main supply lines of the power companies are shown in Fig. 5.

Industrial Progress

Textile manufacturing, the largest individual industry, consumes over 75 per cent of the entire power output of this section. Some idea of the amount required by this industry can be obtained by a consideration of the demand of the mills on a spindle basis. The average requirement for a cotton weaving mill working on 20 to 40 yarns is approximately 1 kw. for 32 spindles. In this territory there are some 8,400,000 spindles which, if all were operating, would require a generating capacity of over 325,000 kva.

There is also the demand of the furniture, tobacco, and miscellaneous manufacturing plants, which is some 15 per cent of the power demand of this section. The furniture factories do not require a large amount of power and in the tobacco plants the demand for steam makes it possible for the plant to generate power economically. As there are no cities in this section with a population in excess of 65,000 there is no large concentrated demand by municipalities. In fact, the power consumption by the public utilities is roughly 10 per cent of the total power demand of this territory.

Demand for Power

The large demands for power within the Piedmont section due to the concentration of its industrial activities are being met economically and efficiently by the development of the water-power resources of North and South Carolina. A brief review of the water-power situation in these states shows clearly the opportunity afforded by the territory in and adjacent to the Piedmont section for the construction of the hydroelectric plants that have made this cheap power possible.

In North and South Carolina in 1922 there was generated 813,332,429 and 832,327,000 kw. hr. respectively. In North Carolina 88.6 per cent of this amount was developed by water-power, and in South Carolina 92.1 per cent and all but a small part of this current was generated by hydroelectric plants constructed on the Catawba and Broad Rivers, which flow in a general southerly direction through the central portion of the Piedmont section.

Index Number
621.311 Electric power supply
38(75) Industries in the South

North Carolina, where two-thirds of the Piedmont section is located, has developed, by water-power, some 450,000 hp. This state is said to contain 2.07 per cent of the total potential waterpower of the United States. It contains 8.9 per cent of the potential water-power of the 26 states east of the Mississippi River—being exceeded by only one state, New York.

TABLE 7. SHOWS THE RELATIONS IN WATER-POWER RESOURCES OF NORTH AND SOUTH CAROLINA TO THE OTHER STATES WHICH ARE SUPPLIED BY POWER SYSTEMS.

Company	Number of Hydro-Electric Plants	Capacity of Plants kva.	Number of Steam Plants	Capacity of Steam Plants kva.	Total Capacity
Southern Power Co	10	375,650	4	92,500	468,150
Under Construction by Southern Power Co.	1	37,500	1	30,500	67,500
Southern Public Utilities	1	16,000	1	950	16,950
Southern Gas & Electric Co.	1	7,200	1	3,000	10,200
Blue Ridge Power Co.	1	6,500	..	....	6,500
Under Construction	1	6,000	..	....	6,000
Total	18	448,850	7	126,950	575,300

The figures for South Carolina are 1.64 per cent and 7.1 per cent respectively, and these two states contain 16 per cent of the total potential water-power of the 26 eastern states. With regard to water-power resources, Table 7 shows the relation of North and South Carolina to the other three states which are supplied by the power systems shown in Fig. 9. The steady increase in the output of the electrical energy by these two states in comparison with the adjoining states, is shown in Fig. 7, and the projection of the line for North Carolina, showing an output of over 1,000,000,000 kva. for 1923 will undoubtedly be exceeded when all of the figures are available. This is an impressive demonstration of the development of these states and particularly of the Piedmont section.

Two interesting situations pertaining to these states are also shown by Fig. 7—the decrease in the power demand of 76 per cent in 1921 due to the industrial depression of that year and the rapid recovery in 1922. In spite of this drop the power output for North Caro-

[1] The first article of this series appeared in MANAGEMENT AND ADMINISTRATION for May 1924, p. 517.

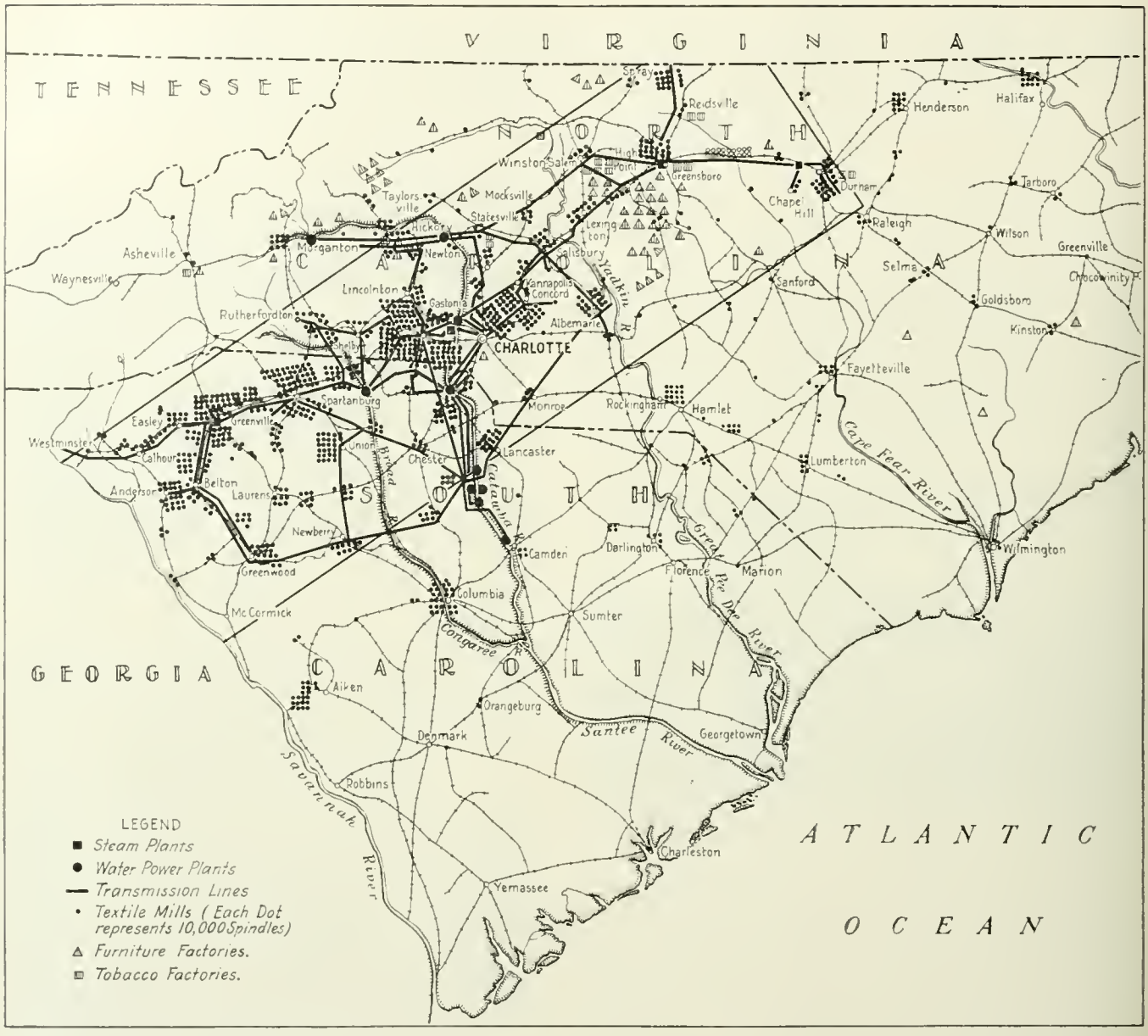


FIG. 5 MAP SHOWING LOCATION OF INDUSTRIAL PLANTS AND MAIN SUPPLY LINES OF POWER COMPANIES IN PIEDMONT SECTION

lina in 1920 was 760,000,000 kva., and 970,000,000 kva. in 1922, an increase of some 30, or 15 per cent per year. Again in 1922 in North Carolina the power output increased 600,000,000 kva. or 200 per cent over that of 1916, or an average of some 33 per cent per year for these six years. In South Carolina the output for 1920 was 720,000,000 kva. and in 1922 this had increased to 830,000,000 kva., or an increase of 7 per cent per year during the period of the severe industrial depression. The output in 1922 for this state was 360,000,000 kva. greater than in 1916 which was an average increase of over 12 per cent per year.

With the increasing power demand in this section there is a notable increase in steam-power generation. In 1920, in North Carolina, the percentage of electrical energy produced by the water-power to the total energy sold was 93 per cent, but this dropped to 89 per cent in 1922. While part of this decrease of 4 per cent was due to the drought of 1921 and 1922, part of it appears to be due to the increased demand for power which exceeded that which was available from hydroelectric development. There is in this state steam-driven electrical generating equipment with a capacity of 475,000 hp., one-third of which is used to support the hydroelectric plants, the remaining two-thirds being installed in manufacturing plants.

There are in this section small industrial water-powers that have been developed by individual plants for their own use and from which they derive cheap power. Some plants have installed steam-driven, electrical generating equipment, and by the purchase of secondary power wherever it is available—as mentioned later in this article—are able to secure power at a low average cost.

The Piedmont section with its rapidly growing power demand, due to the expansion of its textile plants, furniture factories, and miscellaneous industries, is mainly supplied by four companies—the Southern

Power Company, the Southern Public Utilities Company, the South Carolina Gas and Electric Company, and the Blue Ridge Power Company. The installed generating capacity of these four companies can be seen from an inspection of Table 8. In this territory there is also located the enormous plant of the Aluminum Company of America. This plant has an installation of some 113,000 hp., the greater portion of which is used in the reduction of aluminum—the remainder

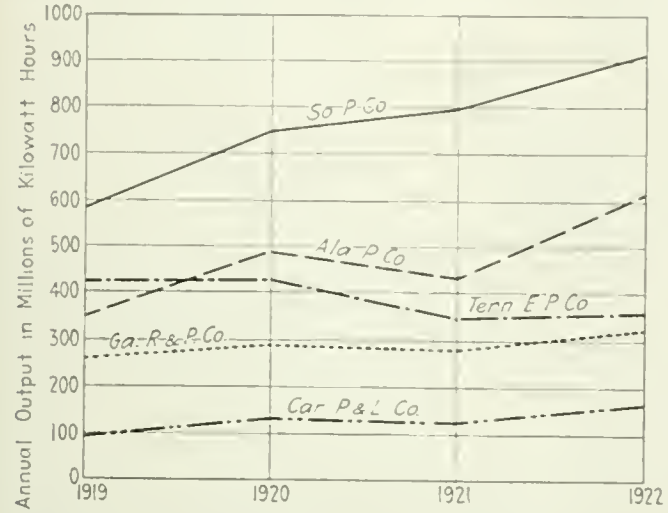


FIG. 6 OUTPUT IN KW. HR. FROM PUBLIC UTILITY COMPANIES IN SOUTHERN APPALACHIAN STATES

being sold to the Carolina Light & Power Company which supplies the territory south and east of the Piedmont section.

This section and the Southern Power Company have developed simultaneously, and the increased output of this company with respect to other companies serving the southern territory of the United States is indicative of the growth of the Piedmont section, as in this area the company disposes of practically its entire output.

Southern Power Company's System

As the installed generating capacity of the Southern Power Company is over 93 per cent of the total generating capacity of the four public utility companies which supply power to the Piedmont section, exclusive of the plants of the individual cities, a brief description of the company's plants and transmission system follows:

The Southern Power Company has 14 generating stations with a total capacity of 468,150 kva. Nine hydroelectric plants with an installed generating capacity of 353,800 kva. are located on the Catawba River, and one of 22,500 kva. is located on the Broad River. As can be seen from Fig. 5, three of the nine plants on the Catawba River with a generating capacity of 122,800 kva. are in North Carolina, and six with a generating capacity of 230,350 kva. are in South Carolina. This river rises in the Blue Ridge Mountains in North Carolina and flows in a southerly direction into South Carolina, crossing the Piedmont section. The crest of the dam at the Bridgewater plant near the source of this river is at an elevation of 1200 ft. and the elevation of the tail race at Wateree in South Carolina plant, 140 ft., a difference of 1060 ft. The total head of water used by the 9 plants is approximately 653 ft., the greatest individual head being 135 ft. at the Bridgewater plant and the lowest individual head being 25 ft. at the Catawba plant. The 99 Island plant, located on the Broad River has a generating capacity of 22,500 kva. operating under head of 70 ft.

The largest and most modern hydroelectrical installation is at Mountain Island, where there are installed four Allis Chalmers generators, driven by Morgan Smith wheels, each with a capacity of 18,750 kva. operating under 83 ft. head, generating 3-phase 60-cycle current, at 6600 volts. The voltage is stepped up by four 23,500 kva. transformers, water cooled, to 100,000 volts for transmission throughout the Piedmont section. The Lookout Shoals Station is shown in Fig. 10 and from this can be obtained an idea of the general type of hydroelectric plant construction.

Steam-Power Plants

The Southern Power Company has three points of water storage. At the Bridgewater plant in North Carolina some 13,000,000,000 cu. ft. are stored; and Mountain Island in the same state has 1,800,000,000 cu. ft.; while at Wateree in South Carolina there are stored 9,000,000,000 cu. ft. This reserve is extremely valuable to the company during the dry period of the year.

There are four steam plants with a total capacity of 92,500 kva., three being located in North Carolina and one in South Carolina. The largest is at Mount

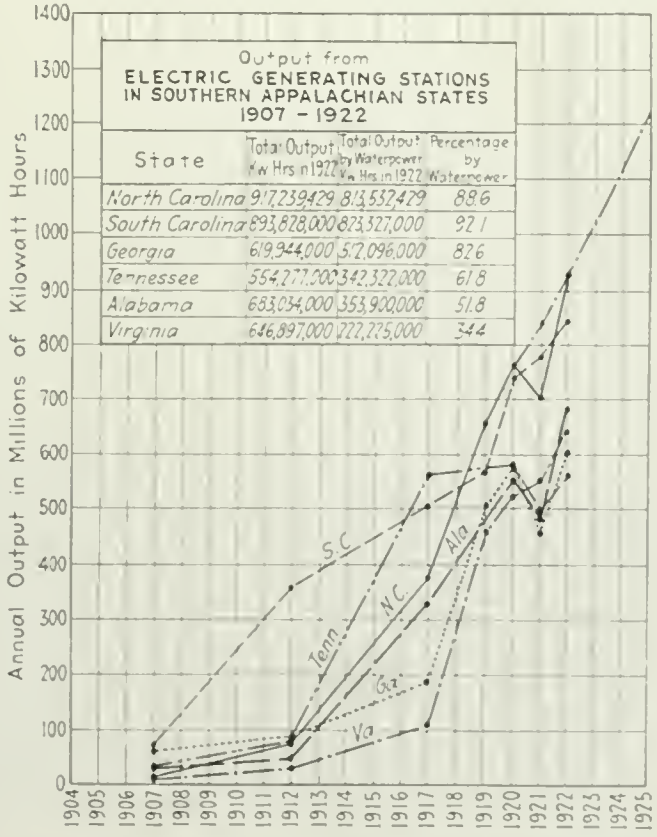


FIG. 7 OUTPUT FROM ELECTRIC GENERATING STATIONS IN SOUTHERN APPALACHIAN STATES—1907 1922

Holly, where additional capacity is now being installed, and at completion this plant will have a capacity of 45,500 kva., consisting of two 18,750 kva., and one 8,000 kva. turbine-driven units.

The transmission system, as can be seen from Fig. 5, runs through all parts of the Piedmont section, and contains some 1710 miles of 100,000 volt line, and 214 miles of 44,000 volt line on steel towers; also 658 miles of line operating at the 44,000 voltage on poles, and 906 miles of 13,000 volt lines on poles. The steel transmission towers are constructed of angle iron and are 75 ft. high with a distance of 45 ft. from the lower crossarm to the ground, the wire spacing being 10 ft. 6 in. Standard types of suspension insulators are used and all these towers are grounded. They are completely galvanized and in some cases where they have been standing 18 years, no rusting is apparent. The spacing is approximately 10 towers to the mile, this varying with the topography of the country. When there is taken into consideration the fact that some 31,000,000 lb. of steel were used in the construction of these towers, and approximately 10,500,000 lb. of copper wire and 500,000 insulators were required to construct the lines, an idea of the size of this system can be obtained. The general construction is shown in Fig. 8, which pictures a switching station and transmission line. Contact is made by this system at four points, with the larger group supplying the five states mentioned above—on the east at Durham, Baden, and Camden with the North Carolina Power and Light Company through other companies which it controls, and on the west at Tullulah Falls, with the stations of the Georgia R. R. and Power Company.

Portable Sub-Stations

An interesting point in connection with the service rendered by the Southern Power Company is its portable sub-stations. To meet an emergency condition due to the disabling of a transformer, this company has 8 portable sub-stations on flat cars with capacities and primary and secondary voltages as in Table 9.

In case of trouble these flat cars can be dispatched to a mill siding or municipality, and in a few hours service can be restored and maintained until such time as the necessary repairs can be made or new transformers procured. When it is realized that in the case of large transformer installations it sometimes takes many weeks to obtain a delivery, the value of the service is apparent.

TABLE 8. POTENTIAL WATER-POWER RESOURCES.

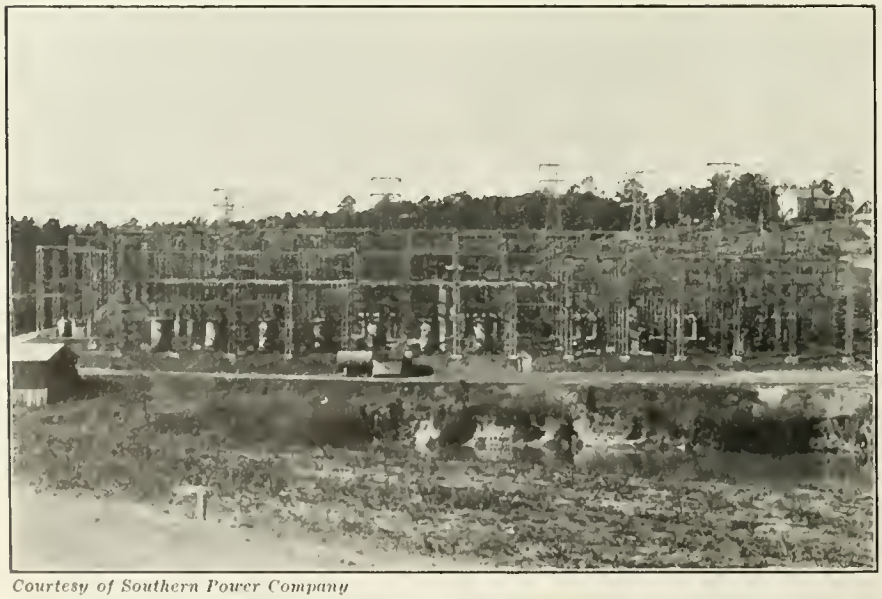
State	Per Cent of Total Potential Power in United States	Per Cent of Potential Power East of Mississippi River
North Carolina	2.07	8.9
Alabama	1.82	7.8
Tennessee	1.66	7.2
South Carolina	1.64	7.1
Georgia	1.34	5.8

TABLE 9. SHOWS CAPACITIES AND VOLTAGE OF EIGHT PORTABLE SUB-STATIONS ON FLAT CARS TO MEET EMERGENCY CONDITIONS DUE TO DISABLING OF A TRANSFORMER.

Number of Transformers	Capacity	Primary Voltage	Sec. Voltage
1	4500 kw.	100,000 44,000 13,000	44,000 11,000 2,200
1	4500 kw.	100,000 44,000 13,000	22,000 11,000 2,200 500
6	200 to 900 kw.	44,000 11,000	1,000 2,000 500

The Southern Power Company sells power wholesale throughout the Piedmont section with one exception, this being the city of Salisbury, where it retails direct to the consumer. Throughout the remainder of this area it sells to the cities and large plants, and when the individual load of a mill or factory in a city limit reaches a certain amount agreed upon between the company and the municipality, it then sells direct to the consumer. Roughly 80 per cent of the load is textile mills, 10 per cent public utilities and 10 per cent miscellaneous factories.

The company sells its power by contract for a term of years under certain schedule rates for primary and secondary power for the various industries, depending on the amount used and the demand. As yet there is no maximum demand charge (although there is a minimum) and no low power factor penalty. As by far



Courtesy of Southern Power Company

FIG. 8 ENLARGED TRANSFORMER AND SWITCHING STATION, SOUTHERN POWER COMPANY, GREAT FALLS, S. C.

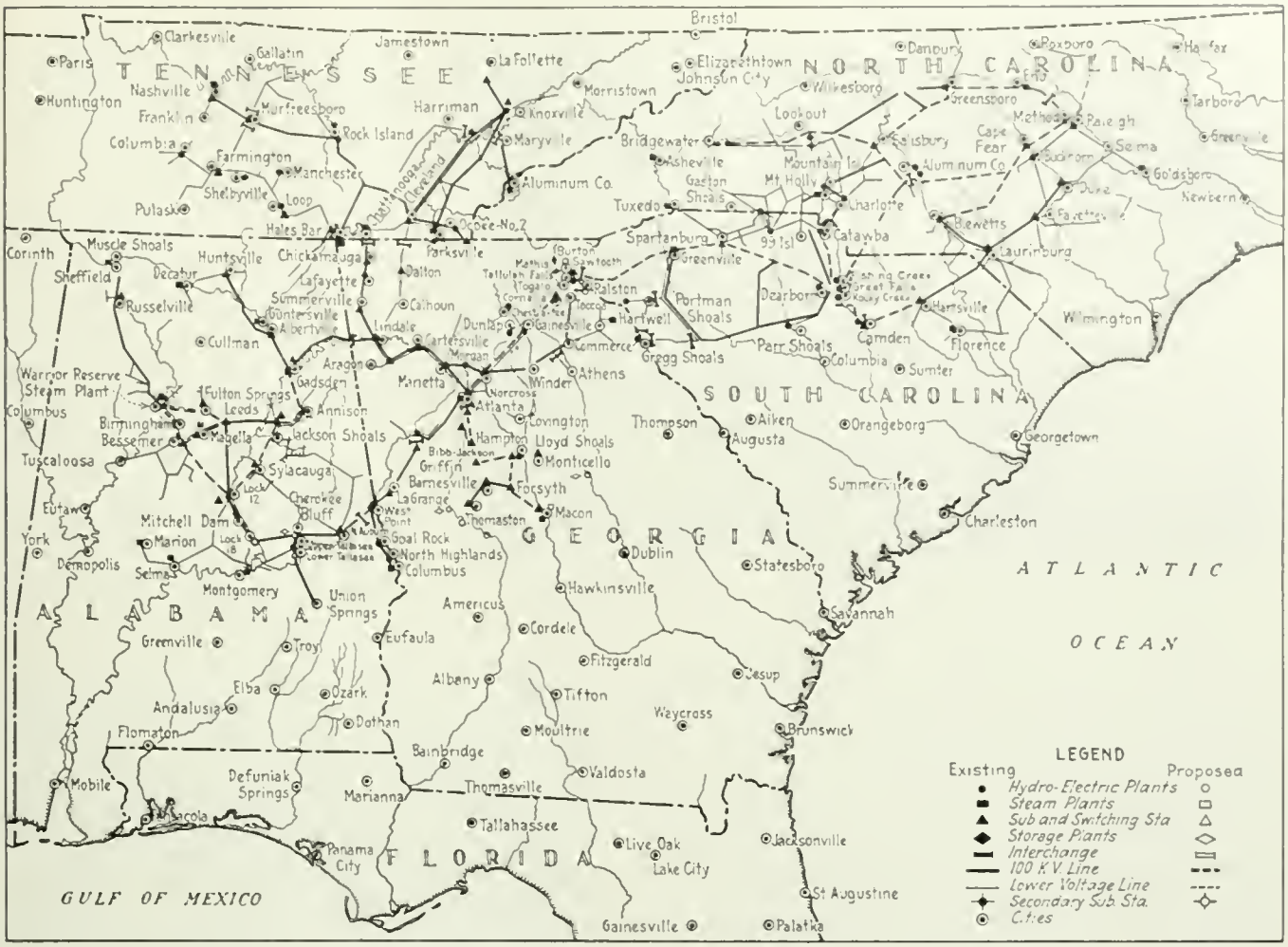


FIG. 9 MAP OF SOUTHERN SUPER-POWER TRANSMISSION SYSTEM

the greater portion of its load is the textile mill which contains a number of small motors, it would be extremely expensive for its consumers to correct their power factor. The rates for primary power for textile and grain mills using 100 kw. and over, and running night or day, starts at $0.014 for the first 50,000 kw. hr. and decreases as the consumption increases, the lowest charge being $0.01 per kw. hr. The rate for miscellaneous primary power starts at 0.06 for the first 50 kw. hr. and decreases as consumption increases, the lowest charge being 0.012 per kw. hr. This covers also the rates for industrial plants not mentioned in the various schedules, and for the municipalities for the purpose of lighting the streets and public places and buildings, and for resale for lighting, heating, and power purposes.

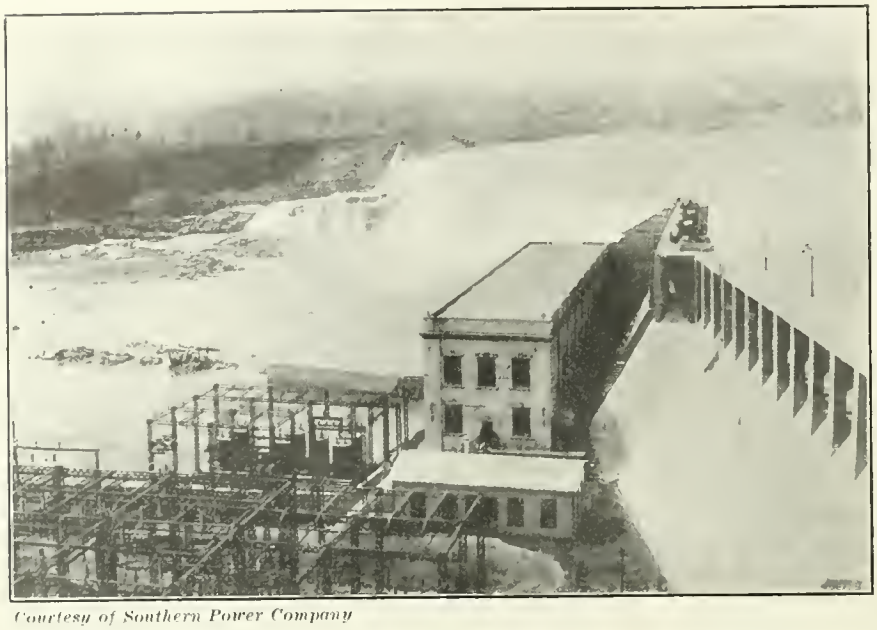
In may cases, manufacturers have found it exceedingly advantageous to purchase secondary power. This power is sold at a low rate, and, during the period that it is available, it affords the industrial plants in this section the opportunity of shutting down the more expensive steam-driven equipment, thus cutting down the power cost of their product.

The secondary power is sold under different rate schedules, and is supplied for 30, 24, or 18 months during a period of three years. This allows the company to dispose of its excess power at convenient periods, due, in general, to a surplus of water-power, which cannot be foreseen with sufficient accuracy to allow for its being contracted for as primary power. The rate for this power on a schedule calling for power to be supplied 18 months during a three-year period is 0.008 for the first 50,000 kw. hr., the rate decreasing with the increase of the amount of current used, the lowest being 0.0078 per kw. hr. The amount of secondary power sold is approximately 13 per cent of the primary power.

Some idea of the growth of this company and the Piedmont section can be obtained when it is noted that this company in 1913 sold a total of 319,079,942 kw. hr., and in 1923 sold a total of 1,001,026,319 kw. hr., an increase of 213 per cent in 10 years.

The Southern Power Company is one of the largest in the South and is one of the seven companies supplying power to the five states of North Carolina, South Carolina, Georgia, Tennessee, and Alabama. (Fig. 9). Its relative output in comparison with four of the largest companies that constitute this system can be seen from Fig. 6, which also shows that in 1920 and 1921 the demand for power upon this company increased while the demand in other sections of the South decreased.

These seven companies form a remarkable power distribution system which is modernly equipped and operated. This system starts at Goldsboro, North Carolina, extends west to Muscle Shoals, Alabama, and



Courtesy of Southern Power Company

FIG. 10 LOOKOUT SHOALS STATION OF THE SOUTHERN POWER COMPANY. CAPACITY 22,800 KVA.

Fig. 9. The United States government steam plant at Sheffield, Alabama, was leased to supply electrical energy in Alabama, allowing that which was generated in this state to be transmitted to the Georgia companies. These companies transmitted the electrical energy thus generated in that vicinity into the Southern Power Company's lines, thus allowing them to transmit the output of their generating equipment, as it was required, to the Carolina Power and Light Company. This interchange of power took place over a distance of 900 miles.

The Southern Power Company has had difficulty in supplying the rapidly increasing power demand of this section, and it now has under construction a hydroelectric plant at Rhodiss with a capacity of 37,500 kva., and a steam plant at Tiger, which will have a capacity of 30,000 kva., making a total generating capacity of 67,500 kva. The building program of this company—if carried out—will place it in a position where it can easily supply the power load of this territory.

it is one of the largest transmission systems in the United States. It is 550 miles long and its distance from Nashville, Tennessee, its most northerly point, to Montgomery, Alabama, the southerly extremity, is some 250 miles, as can be seen from Fig. 9. It is composed of seven individual power companies, which operate 36 hydroelectric plants and 25 steam plants, the combined installed generating equipment being some 1,300,000 kva., of which some 900,000 kva. or 70 per cent is operated by water-power. These companies transmit electrical energy at 110,000 and 100,000 volts on their trunk lines and at lower voltages on the distribution lines throughout the states of North Carolina, and South Carolina, Georgia, Tennessee, and Alabama. The support that each of the individual companies of the system receives from the adjoining companies insures a constant supply of power that creates an extremely favorable situation for the industries of this section of the United States.

The interconnection of these companies increases the reliability of power supply of the individual companies and assists in raising the load factors, as the peak loads in a system covering so large a territory with diversified manufacturing demands may come at different hours, thus allowing the transmission of electrical energy from one company to another to meet the peaks of the various industrial systems. The ability to interchange power also makes for economy of operation, and therefore assists in maintaining the low rates that exist in this territory. A case in point is that which happened in the fall of 1921 and 1922 when the severe drought cut down the output from the plants of the Carolina Power and Light Company, located at the eastern extremity of the systems, as may be seen from

There are two outstanding advantages in the power situation throughout the Piedmont section. First, abundant water power makes possible the cheap generation of electricity either by individual plants, or by the public utilities companies. Second, the interconnection of transmission lines assures uninterrupted service from steam plants, or from other hydroelectric plants when drought or breakdowns cut off any of the water power units. Cheap and reliable power is of inestimable value in building up a manufacturing community and the growth of industry in this section is to a large extent attributable to this advantage.

Courtesy of Southern Power Company

FIG. 11 GREAT FALLS STATION. OLD AND NEW TYPE OF HYDROELECTRIC PLANT CONSTRUCTION

Acknowledgment is due Charles I. Burkholder, General Manager of the Southern Power Company, and E. C. Marshall, President of the Southern Pacific Utilities Company, and their organizations, for their assistance in collecting the data for this article.

(To be continued in the July issue)

Organizing to Prevent Materials Waste

Prevention and Salvage of Waste at Westinghouse Plant

By C. B. AUEL

Manager, Employee's Service Department, Westinghouse Electric and Mfg. Co.

Index Number
658.516 Standardization

MANUFACTURING concerns throughout the country have, within the past few years, been giving attention to the solution of the problem of the prevention and utilization of the material wastes heretofore attendant in the manufacture of their apparatus. They realize that, with increasing competition, such accomplishment will add to their profits more effectively, and be more practicable, than an increase in selling price.

Like many other problems, its full extent was not originally understood, the result being that study was first given to the possible utilization of these wastes, and only comparatively lately has it begun to be appreciated that many of the wastes, heretofore considered inevitable, can either be largely reduced, or actually prevented.

FIG. 1 BAR STOCK STORAGE
Orderliness can be maintained by using orderly methods.

In this connection, it is only fair to state, however, that the prevention of wastes of all kinds is more easily accomplished with the standardization of product. And, as many of our industries can still be said to be either in the development state, or else lacking standardization, reasons are therefore to be found for the seeming want of appreciation of the full extent of the problem.

It may be said without fear of contradiction that the present generation has actually been educated by manufacturers, to a large extent through the advertisement of their products, to believe that anything special or having special features connected with it, is to be desired over and above the common variety. On the contrary, the very reverse of this is, in the main, true, as will be evident upon a moment's thought; for, the further a thing departs from the common or well-known and the more it incorporates the special or lesser known, the more liability there is that it will be either unable to fulfill specifications, or else fail to function properly. It may be said further that this great lack of standardization has undoubtedly more to do with high cost of the finished product than any other one item, even of labor. Until, therefore, this deep-seated opinion on the part of the public can be reversed—and to do so would first require the attitude of the manufacturers of many of our commodities to undergo a change—the prevention and utilization of wastes cannot of necessity make the headway otherwise possible.

In a discussion of this kind, confined though it is to material wastes, the very number and diversity of manufacture render it quite impossible to set down in any detail methods for either waste prevention or utilization which would be applicable to all industries, or even to give an outline of certain principles to be followed by all, so that the problem must still remain unsolved for many of the industries.

In what follows, no reference is made to savings which may be effected by simplification of product, due to the use of preferred numbers or sizes and the consequent elimination of others, as such lie outside the range of the present article.

Standardization of Parts

When designing any commercial apparatus, consideration should always be given, among other things, to the prevention of possible wastes in connection with its building and subsequent operation.

This apparently fundamental statement has in mind something quite different from the simple and obvious one of hewing to the line, and making the various parts, each with its requisite factor of safety, and avoiding an unnecessary surplus of material. It refers more particularly to the use of the most appropriate materials—not special, but rather commercial or manufacturers' standards wherever possible—and the selection of these, as well, with proper reference to size, bearing in mind the further application of every such kind and size to other apparatus, either of the same line or even of a different line.

Consideration should be given, furthermore, to the possible use of pressed or sheet material in place of castings, especially where there is a cost of a long haul to be taken into account, such as is involved in ocean or trans-continental shipments, and where the difference in weight would be of some importance. The item of uniformity in quality of output from the

use of such material, with consequent decrease in rejections owing to defective material, should likewise be given due weight. This last advantage plus the ability so to mold to finished size as to eliminate many labor operations will undoubtedly also lead to a gradually increasing use of molded materials and die castings in smaller items, as time goes on.

It is further good policy, where there are more or less pronounced fluctuations in the market prices of certain raw materials and when in the design of apparatus a choice may be sometimes made, to keep the engineering department advised of comparative prices, so that such choice may be made and corresponding savings effected.

Somewhat similar consideration as outlined for productive materials should also be given to the so-called expense materials which are used in every factory, frequently in appreciable quantities, yet which do not enter into the construction of the apparatus itself; as for example, shafting, pipe fittings, lumber, nails, screws, leather, small tools, waste, etc.

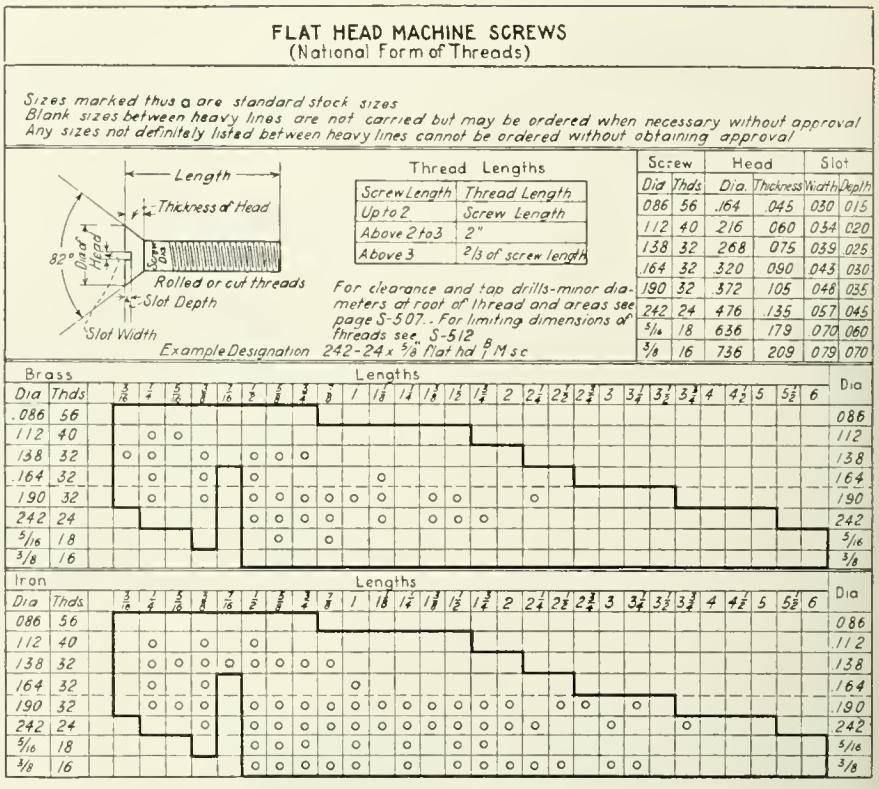

FLAT HEAD MACHINE SCREWS
(National Form of Threads)
Sizes marked thus a are standard stock sizes
Blank sizes between heavy lines are not carried but may be ordered when necessary without approval
Any sizes not definitely listed between heavy lines cannot be ordered without obtaining approval
Length
Thickness of Head
Rolled or cut threads
Slot Depth
Slot Width
82° Diam. of Head
Thread Lengths
Screw Length | Thread Length
Up to 2 | Screw Length
Above 2 to 3 | 2"
Above 3 | 2/3 of screw length
For clearance and tap drills-minor diameters at root of thread and areas see page S-507. For limiting dimensions of threads see S-512
Example Designation 242-24 x 5/8 Flat hd B M s c
Screw | Head | Slot
Dia | Thds | Dia. | Thickness | Width | Depth
.086 | 56 | .164 | .045 | .030 | .015
.112 | 40 | .216 | .060 | .034 | .020
.138 | 32 | .268 | .075 | .039 | .025
.164 | 32 | .320 | .090 | .043 | .030
.190 | 32 | .372 | .105 | .048 | .035
.242 | 24 | .476 | .135 | .057 | .045
5/16 | 18 | .636 | .179 | .070 | .060
3/8 | 16 | .736 | .209 | .079 | .070
Brass
Lengths
Dia
Thds
Iron
Lengths
Dia
Thds

FIG. 2 STANDARDS SHEET

Contains standard specifications developed by the Standards Division.

Standards Division

The preceding situation has been very well met at Westinghouse by the creation of a standards division of the engineering department and a Standards Committee, whose functions have primarily to do with the problem of waste prevention; and, as both of these setups are of wide application and admirably adapted to many concerns, large and small, a description of them, somewhat in detail, will not be out of place.

Taking up the standards division first, its duties include the recording in suitable shape of all productive materials used by the engineering and the manufacturing departments in the design and construction of apparatus made by the company, and of certain expense materials used throughout the factory as well. The gathering together of this data has been the means of showing, more particularly when such work was first undertaken, that there was much diversity as to kinds and sizes of materials actually entering into the apparatus built—more so as to sizes than kinds—and also of small tools and other expense materials used, and seemingly more of both than was necessary or desirable.

Preparation of Standards

The following tabulation will illustrate very clearly the condition originally found with respect to certain stocks, both of productive and expense materials, as well as the outcome of the efforts made to eliminate some of these wastes. These items were typical of the situation existing generally before and after the work of the standards division became effective:

MATERIAL	ORIGINAL STOCK SIZES	PRESENT STOCK SIZES
Steel tubing	35	20
Brass tubing	206	90
Copper tubing	78	37
Slate	336	70
Soapstone	150	0
Cable	350	180
Oil rings	72	44
Lock washers	45	39
Hammers	36	30
Files	180	30

Of course it was obviously the thing to do to reduce the kinds and sizes of materials to a minimum at as early a date as practicable but, the way to go about it was not so obvious, bearing in mind the fact that custom had established certain practices, that orders for wearing parts would continue to be received from time to time, and that the same item for which a substitute might readily be found in one line of apparatus could perhaps hardly be dispensed with in another. Aside from these considerations, there were also to be taken into account the work and the expense involved in changing drawings and making records of the date on which such changes would go into effect. These last two features were soon seen to be the most important considerations of all; considerations which if deemed essential would retard if not wholly defeat any attempt at simplification.

The solution, perplexing as it seemed at first, was, however, readily found, and consisted in the simple de-

cision to make no changes retroactive but to apply them on new apparatus only, and this decision with very few exceptions has since been followed. With these stumbling blocks removed, it was only necessary to devise some system which might be followed by all departments on new work and which would direct their choice along certain previously determined and logical lines. In the more simple items the standards division could, from its own knowledge of conditions, usually develop suitable sequences of kinds and sizes; but these first required general approval by all of the departments which would be likely to use them before they could actually be put into effect.

Standards Book

Upon this approval being secured, the standardized data was then set down on a standard sheet, as shown in Fig. 2, and copies were distributed to the various departments and individuals interested. At a later period, these sheets were incorporated into a Standards Book for preservation and ready reference. It is almost unnecessary to state that changes have been found to be necessary from time to time in these provisional standards, as they may be called; but these have gradually become fewer and fewer from year to year, until the work of the standards division is now more nearly what its name implies.

By making all requisitions for materials needed from outside sources pass through the standards division enroute to the purchasing department, opportunities are afforded to check adherence to these lists of materials and to see that special items or sizes are either headed off, or at least referred back to the proper parties for additional approval or possible substitution, before being allowed to go through, and thus the kinds and sizes of materials have been constantly kept within reasonable and economical limits.

The more complex matters, and these include not alone materials but certain data as well, which it is equally important to treat, if possible, in much the same way as those just described, are usually referred to the Standards Committee. This committee might be called a "revolving" one, as but two of its members, the chairman and the secretary, are permanent; the others, of whom there may be as many as seven or eight, changing as occasion makes necessary. Its method of working is as follows:

When a subject arises which to the chairman and secretary would seem to offer some possibilities in simplification, improvement, or standardization, a sub-committee with its chairman is appointed from among those who are most familiar with it, always including a representative of the standards division who acts as secretary. This sub-committee is given an outline of what it is hoped to accomplish and at once starts its work, holding meetings as often as required, and calling into their meeting others whom they feel would be able to assist them. Any data deemed necessary by the sub-committee in its deliberation is compiled or supplied by the standards division; and, when a test or experiment may be felt to be expedient to determine certain conclusions, an appropriation is asked for this purpose from the management of the plant.

Functions of Sub-committee

As many as six or eight of these sub-committees may be working at once and sometimes a member of one sub-committee may also serve on another. In serving on these sub-committees, the members are not supposed to fall behind in, or to neglect, their regular duties; and for this reason, more time is sometimes required for a sub-committee to make its report. Upon the completion of its work, each sub-committee submits its report to the chairman of the main or Standards Committee; and, if it seems to him to have met requirements, a call for the general meeting is issued to the chairmen of all of the various outstanding sub-committees, who will thus be seen to be the other or revolving members of the Standards Committee. This main committee in due course passes upon the report of the sub-committee, and, if favorably approved, it is referred by it, in turn, to the management for final approval. Upon receipt of this approval, the sub-committee is dissolved when the chairman ceases to be a member of the Standards Committee.

SUB-COMMITTEES

No.	Subject	No.	Subject	No.	Subject
1.	Babbits and Solders	14.	Trucks, Barrels and Wheel Tote Boxes	27.	Tubing — Brass and Copper
2.	Allowable Variations from Drawing Dimensions	15.	Counterbores and Facing Tools	28.	Springs—Material
3.	Punched Circular Washers	16.	Pulley Sizes	29.	Slot Files—Machinists'
4.	Tap Drills Tap Drills–Reopened	17.	Anchor Plates and Foundation Bolts	30.	Cleats
5.	Eye Bolts—Allowable Stresses	18.	Rigid Couplings	31.	Oil Rings
6.	Bearing Babbit	19.	Finish Allowances on Bolts and Nuts	32.	Welding–Illustrations and Definitions
7.	Furniture Standards	20.	Steels for Tool Room Use	33.	Bed Plate Design and Method of Lifting
8.	Handle Grips	21.	Shaft Allowances for Pulley Fits	34.	Passes for Employees
9.	Ferrules	22.	Keys	35.	Protective Treatment for Materials to be Soldered
10.	Thumband Wing Nuts	23.	Punched Nuts vs. Machined Nuts	36.	Paper Forms
11.	Storeroom Fixtures	24.	Spot Welding	37.	Lumber
12.	Anchor Holes in Bearings	25.	Springs — Reduction of Sizes	38.	Belting
13.	Marble, Slate and Soapstone Bases	26.	Hammers	39.	Fiber and Paper Containers
				40.	Storing Employees' Clothing

FIG. 3 SUB-COMMITTEE CHART
Contains a list of specifications developed by the Standard Division.

It may be said that this Standards Committee has nothing to do with the design of apparatus as such, except, of course, as future designs may be effected indirectly by the work of elimination, simplification, or standardization.

The range of work covered in this way by these sub-committees has been very wide, more so than would

seem at all possible by a cursory examination. It has embraced not alone productive and expense materials, but even shop and office equipment and tools as well. In fact, some of the subjects thus handled could hardly appear to have been so satisfactorily settled in any other manner as will be appreciated from the really extensive range given in Fig. 3, which shows but a part of the ground covered. It should further be said that occasionally these sub-committees have, from the very nature of the work assigned to them, not been able to turn in their findings until after the lapse of one or more years, and occasionally their reports recommend a resurvey of the situation at a later period, when additional steps in simplification may then be considered.

From the preceding, it will be seen how a procedure such as described, works toward the prevention of wastes of one kind and another, by reducing the varieties and quantities of items otherwise thought necessary to be carried in stock, some of which may never be used, due to changes in design or to other conditions. Physical space is also saved in the storerooms, as is the clerical labor entailed in keeping records. Additional to all of these savings, there may be on occasion still another kind of saving, not to be mentioned in money values, but a worth-while saving nevertheless, as when a sub-committee is appointed to standardize on a subject like "A practical method of storing wearing apparel for employees during working hours".

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
(Including Branch Works and Subsidiary Companies)

Purchasing Department Specification No. 3526

ANNEALED SPRING STEEL WIRE

1. This specification covers bright annealed steel wire to be used for springs.

I—MANUFACTURE

2. *Process:* The steel may be made by the crucible, electric furnace, or open hearth process.

II—CHEMICAL PROPERTIES AND TESTS

3. *Chemical Composition:* The steel shall conform to the following requirements as to chemical composition:

Carbon	0.90 to 1.10 per cent
Manganese	0.25 to 0.50 "
Phosphorus, max	0.05 "
Sulphur, "	0.05 "
Silicon, "	0.25 "
Copper, "	0.05 "

III—PHYSICAL PROPERTIES AND TESTS

4. *Physical Properties:* The wire shall be of such toughness that it will bend 180° flat upon itself without cracking or splitting.

IV—DIMENSIONS

5. *Permissible Variations:* The wire shall not vary from the specified diameter more than the following amounts:

Diameter of Wire Inches	Permissible Variations Plus or minus—Inches
0.035 to 0.049 incl.	0.001
Over 0.049 to 0.090 "	0.0015
" 0.090	0.002

V—FINISH

6. *Finish:* The wire shall be free from injurious defects and shall have a workmanlike finish.

VI—PACKING AND MARKING

7. *Packing:* The wire shall be shipped in coils, not over 2 feet inside diameter, properly protected against injury.

8. *Marking:* Each coil shall be plainly marked as follows:
Requisition number.
P. D. Spec. 3526.
Bright annealed spring wire.
Diameter of wire.
Name of manufacturer.

For example: Req. C-6100; P. D. Spec. 3526; Bright Annealed Spring Wire .080S inch; Blank Mfg. Co.

VII—REJECTION

9. *Rejection:* The purchaser reserves the right to reject any portion or all of the material which does not conform to the above specification in every particular and to return the rejected material to the manufacturer or seller for full credit at price charged f. o. b. point of delivery specified by the purchaser. If the material is to be replaced, a new order will be entered at prices, terms and conditions acceptable to the purchaser.

Approved: February 21, 1921
Annealed Spring Steel Wire.

FIG. 4 PURCHASING SPECIFICATION SHEET

Where practicable, such sheets are compiled for all materials which are purchased from outside concerns.

MATERIAL No. 1696

ACID, SULPHURIC, CHEMICALLY PURE.

USED BY—E. Pgh.

FURNISHED BY—Open Market.

PURCH. DEPT. ORDER AS—C. P. Sulphuric Acid.

CHARACTERISTICS—Is a chemically pure sulphuric acid. Specific gravity must not be less than 1.84, absolute at 15.5° C. (60° F.). Weight per cubic inch .0664 lb.

APPLICATION—For use only in laboratory.

SPECIFY AS—C. P. Sulphuric Acid No. 1696.

REFERENCE: Materials Sect. M & P Eng. Dept. E. Pgh. Tel. 390.

FIG. 5 APPROVED MATERIAL CARD

Serves same purpose as Fig. 4, and is used for ordering materials which do not require detail specifications.

Purchasing Specifications

Controversy has existed the country over as to whether or not there should be purchasing specifications covering such raw materials as a manufacturing concern requires. The mere existence, however, of such an organization as the American Society for Testing Materials would seem to be the best answer that can be made to any argument against the development and use of purchasing specifications. It is claimed that purchasers should have sufficient confidence in the suppliers to make specifications of this kind unnecessary. The reason is specious but not sound as materials having the same general trade names may differ widely both in their physical characteristics and in their chemical components, and certainly specifications will avoid misunderstandings, if nothing else, as to what is required. While upholding the statement previously made that commercial or manufacturers' standards should be adhered to and used whenever possible, and therefore no specifications usually being necessary for them, there is, nevertheless, still need for covering some of this class, as well as other materials, by purchasing specifications; and, of course, these specifications are invariably indicated when made-to-order materials are purchased.

In developing a purchasing specification, it is advisable to secure, if possible, specifications already in use by other consumers of similar material, who upon request will almost invariably give the benefit of their advice and experience on any particular material, the more so if it is a matter of reciprocity. Having prepared a tentative specification, based both upon what is desired and upon actual experience, it is further advisable to submit it to several manufacturers of the class of material involved and obtain their comments. By following this plan, a really practical set of purchasing specifications can be built up.

Westinghouse makes it a practice in developing pur-

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
EAST PITTSBURGH, PA.

Process Specification No. 115388-B — Jan. 31, 1922. Changed Dec. 21, 1923.

PRESERVATIVE TREATMENT OF WOOD AND FELT.

GENERAL:
This specification covers the process to be followed in treating wood, felt, and other similar material, in order to preserve it. This treatment is also effective against the attacks of insects.

PROCESS:
Operations:
Treating
Drying

Treating—Pack the material to be treated in baskets, or other suitable containers, and immerse at room temperature in a tank filled with preserving compound. Allow to soak in this solution for from six to fourteen hours, depending upon the size of the material. The preserving compound should be used as received, but if it should become too heavy it should be thinned to the correct density by the use of heavy naphtha.
Drying—Remove the material from the tank and allow to drain. Then place the material on a drying rack, separating it so that air will circulate through it, and allow to remain until dry.

MATERIAL	MATERIAL NO.
Preserving Compound	2980
Heavy Naphtha	2024

APPROVED: *T. D. Lynch*, Engineer — Jan. 12, 1924
ACCEPTED: *R. L. Wilson*, Works Manager — Jan. 14, 1924

FIG. 6 MANUFACTURING SPECIFICATION SHEET
Developed for productive operations to show approved methods.

chasing specifications to follow the arrangement adopted by the American Society of Testing Materials, Fig. 4; or where specifications do not seem to be practicable or required, to have approved material cards, Fig. 5, on which are listed the names of suppliers whose goods have been tested and found to be satisfactory. Endeavor is always made to have several suppliers for each material from among whom to choose, on the principle that it is not wise to put all of one's eggs in one basket. A further precaution is also taken to see that any supplier's goods, which have not been tried out or used within a period of 18 months, are treated as though offered by a new supplier and tested again before orders are placed with him. This procedure has been deemed necessary to guard against any lowering in the quality due to competition or for any other reason.

If purchasing specifications or standards are considered necessary for materials or apparatus coming into a factory, it would appear to be only logical that an equivalent check should be equally necessary on materials or apparatus going out of a factory. This statement, like an earlier one, means something more than the obvious one of an inspection department. It means, in fact, the establishment of an aid to, or the auxiliary of, an inspection department in the way of manufacturing or process specifications and such specifications may take a variety of forms.

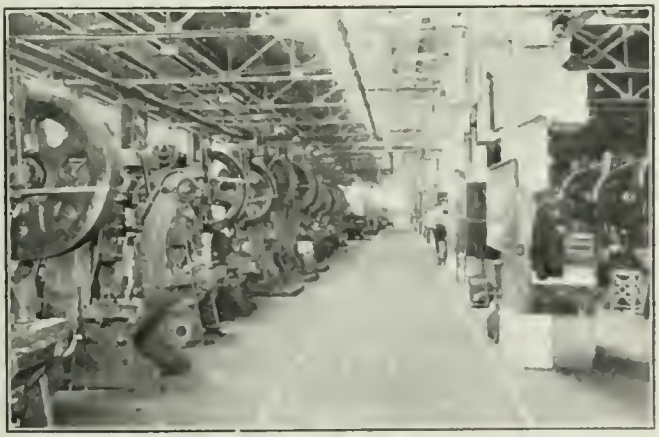


FIG. 7 GENERAL VIEW OF FACTORY FLOOR SHOWING ORDERLY ARRANGEMENT THAT MAY BE MAINTAINED BY PROPER ORGANIZATION

Manufacturing Allowances

It is rather surprising to find concerns still adhering to the out-of-date practice of placing on drawings only the nominal or exact dimensions, without at the same time setting down the absolutely necessary permissible variations either way from them. This lack of information has several very decided disadvantages. It prevents the operation itself from being done in minimum time, because the workman will almost invariably slow down in an endeavor to arrive at the exact dimensions specified, yet keeping, as a precautionary measure, on the safe side of such dimensions, provided he knows which is the safe side. It also entails unnecessary delay on the part of the inspection department in determining whether or not the piece when finished actually comes within sufficiently close limits to permit the work to be passed. This time-consuming determination must be gone through practically every time such work is done. Spoiled work also results in addition to higher direct labor (operation) and indirect labor (inspection) costs.

Wastes of this kind are largely prevented, however, by the simple expedient of placing the permissible limits on the drawings, or else by having limit sheets containing the permissible variations for certain classes or sizes of apparatus. Such a sheet might be termed a manufacturing or process specification in its simplest form. The same method may, however, be pursued to advantage with even complicated processes, Fig. 6, each step being clearly set forth as to actual ingredients to be used, amounts of each, times and sequence of operations, finished sizes, shapes, etc., so that there can never be any question as to whether or not the work is being done correctly, besides which greater uniformity in product is obtained and maximum speed secured.

Results from Manufacturing Specifications

As improvements in manufacturing processes are made from time to time, these specifications may be altered to correspond, and thus there is always a continuous record of all changes with no likelihood of any repetitions of earlier errors which may have been made, something which cannot be avoided with any hit-and-miss method of keeping records or of issuing instructions.

But perhaps as great an argument as any in favor of manufacturing specifications is that there is always a standard way of doing a thing, regardless of changing personnel, with its differing notions or views as to how a thing should be done, for there is perhaps nothing quite so demoralizing to the rank and file, aside from lack of discipline, as changing methods of work.

Manufacturing specifications cannot, of course, cover all of the work done, nor all of the materials used in the factory of any size, neither is it desirable that they

should do so, as such would result in carrying an excellent scheme to a ridiculous extreme, and defeat, in large measure, the very purpose for which it is intended. A survey should be made, therefore, of a factory, from time to time, with the idea of ascertaining whether or not certain work (other than straight production work), is being done uniformly in those departments in which it may be common, or the same materials used on the same classes of work.

The necessity for this may be readily seen by the use of a lard oil or colored waste in one department, when cheaper cutting oil or wiping rags are used in another department; or blue-prints may be collected every week-end and returned to stores in one department, while in another they may not be returned until the job is completed, or even later, thus requiring several of the same blue-prints to be furnished; or material may not be unloaded promptly when received, tying up trucks too long and thus causing delays in other departments, or an increase in trucking equipment and so on.

(To be continued in the July issue.)

Building a Successful Sales Manual

By F. JURASCHEK

Index Number
658.807 Sales manuals

THE problem of writing a sales manual that is exactly fitted to the needs of his own business is causing many a sales manager much concern these days. The need for such a manual is acknowledged almost universally, and some extraordinarily fine examples have been produced recently by men of talent and vision. One of these in particular is worthy of comment, as it embodies the experience of many years of planning, and the critical comments of many sales managers and salesmen. As a consequence it has been successful in its purpose and application from the first minute of its issuance to the salesmen in the field, and has been used by them constantly in their every-day work.

The company manufactures builders' hardware and maintains a selling force of about 35 men in this country. A decade ago it issued to its salesmen a book of instructions covering in detail the duties and responsibilities of these men in calling on several classifications of the trade, and laying down definite rules for the use of order and report forms, expense accounts, etc. This was far from being a sales manual, however, since in tone it was peremptory and consisted almost entirely of "Thou Shalt Not" and "Thou Shalt".

Now that is decidedly *not* what a sales manual should be. Yet, since even today many sales managers lean toward that mid-Victorian ideal, it may be worth while here to define in detail what it should be, according to the latest thought. A sales manual is an authoritative handbook, for the salesman's personal use, that will provide at a moment's notice an answer to every question that is likely to arise in the course of a sales argument. It is a textbook that covers in detail every point that has been brought out in the combined sales experience of all the salesmen and sales managers in the past, and puts that valuable information at the command of each of the present salesmen.

Description of Manual

Such a manual describes the history and organization of the company in brief, outlines the sales and manufacturing policies, explains the functions and correlation of each department of the business, gives the details of the design and manufacture of the products, expounds the selling points of those products, compares them with competing products, and pictures graphically the salient statistics of the business. In other words, it provides every day in the year, the elements of an Annual Sales Convention.

This successful Hardware Sales Manual was built strictly in accordance with the above definition. An editor was appointed to plan the outline, to edit the contributions, and to complete the book as a definite, coherent whole. Since it is more than possible that many of the ideas elaborated in this manual can be adapted with slight modifications to many other lines of business in which the distribution is from manufacturer to retailer to consumer, a resumé of the material composing each chapter is here given.

The entire book is composed of 225 loose-leaf pages, of letter-head size, bound in a leather ring binder with stamped cover. The fly leaf contains the serial number of each particular copy and a word of caution to the salesmen that the information in the book is strictly confidential, and that the entire manual is the property of the company, loaned to the salesman only during the period of his active association with the company.

Contents of Manual

The Foreword explains briefly that the manual is designed to help each salesman to better his efforts, broaden his viewpoint, add to his knowledge of the line, and give him a clearer conception of the aims and purposes of the company. It further points out the fact that it offers each salesman specific data upon which he can build a scientific plan of salesmanship, and also shows him how every department of the company is co-related in the scheme of manufacturing-merchandising.

This is followed by views of the plant and various manufacturing operations, by pictures of the executives of the company, and personal, signed messages from the president, the vice-presidents in charge of manufacturing and sales, the general sales manager, and the sales managers of the hardware sales departments. This completes the introductory matter.

Chapter I—History and Organization of the Company. Every salesman should have, as a background for his sales effort, a thorough knowledge of the history and organization of his company. The history may best

be given briefly, but stress is laid here on the story of the growth of the line, with illustrations of original product, rather than on the changes in corporate personnel. Where products formerly made have been dropped from the line, illustrations are given and the reasons for their discontinuance. The present organization is described and charted, to show the ways in which departmental effort is co-related, and where the line of authority lies.

Chapter II—Policies of the Company. (By the President.) In this chapter the president of the company writes briefly on the following topics: The policy of organizations; reasons for the present form of organization of the company. The policy of management; the necessity of earning dividends for stockholders, and its influence on the management. The policy of manufacturing; how and why the high standards of manufacturing of the company are adhered to. The policy of distribution; the place of the jobber and the retailer in the merchandising scheme, the principles of classification of the trade, and how salesmen's territories are allocated. The policy of selling; the fundamental bases upon which the company's products are merchandised. The policy toward competition; how it is met and why it is welcomed.

Chapter III—How Our Products Are Made. (By the Vice-President in Charge of Manufacturing.) Here the general story of the manufacture of the products is told, from designing to final inspection. Figures are given to show the size of the plant, the boiler horsepower of the power plant, the current consumed in manufacturing processes, the value of the plant equipment, the volume of product manufactured in a year, etc. Here, also, is told the story of the plant employee welfare work, the conditions under which the men work, the safety first measures adopted for their protection, the works hospital and dental clinics, the library, and the group insurance.

Chapter IV—Our Products in the Making. (By the Foremen.) Then, in contrast to the *general* story in the preceding chapter, the *specific* story of the manufacturing is told here. The chapter is made up of a series of signed articles by the foremen or superintendents in charge of the different operations, covering in considerable detail the essential facts relating to the design of the products, the making of patterns, casting, stamping and forging, etc., assembling and final inspection. This chapter is designed to enable the salesman to answer intelligently any question that may be asked in the course of a sales talk as to the methods employed in making the products he is selling.

Chapter V—Practical Salesmanship. (By the Vice-President in Charge of Sales.) Just as the last two chapters treated of manufacturing first from the general and then from the specific viewpoint, so here, in the first chapter on selling, the general viewpoint is first taken up. This is the enthusiasm-building chapter, as may be noticed from the subjects treated:

The romance of business; the dignity of salesmanship; general theories of selling; the executive attitude of a salesman toward his work; concentration; personality; why some salesmen are popular; visualizing the prospect's needs; selling vs. entertaining; the big customer; the small town prospect; staging yourself; initiative; character; the need for variety in the sales argument; working systematically; dominating through positive knowledge; the secret of persuasive talking; endurance; meeting competition; meeting objections; quality versus price; service; what a salesman should read; keeping abreast of the times; newspapers, magazines, trade papers, books; the place of each in a salesman's life; learning from the experiences of others; the value of pure theory; how to transmute pure theory into practical selling; the psychology of correct thinking, etc.

Chapter VI—The Hardware Industry—and Ourselves. (By the General Sales Manager.) In this chapter a bridge is made between the generalities of Chapter V and the specific sales arguments introduced into Chapters VII, VIII, and IX. The subjects treated are:

A brief description of the hardware industry in the United States and Canada; what it consists of; how it is organized; the variety of products; methods of distribution; the jobber; the retailer; the situation today; the future outlook; our place in the hardware industry; how it has been won; what we are doing to maintain that place; the value of our trade-mark; what our trade-mark stands for; how our leadership has raised the standards of the industry; our salesmen are expected to help maintain that leadership.

Chapters VII, VIII, and IX—Selling Our Products. (By the Sales Manager.) Since this particular business manufactures three general classes of hardware of which the uses vary widely, three sales managers are employed, each a specialist in the sale of one of these classes. But, since all three classes of hardware are sold through the retail hardware stores, each salesman handles all three classes, and thus has in effect to report to three sales managers. Therefore these three chapters, each covering one class of product and signed by the sales manager of that class, are included in every copy of the sales manual.

Each chapter works from the general to the specific and covers in fair detail every standard sales argument used in selling the products; covering such points as: Who are the consumers; where are they located; what are the fundamental sales appeals; what part of the market is already sold; what are the competing products; what are the competitors' advantages; what are our advantages; building on the consumer's goodwill; meeting objections; the intelligent use of samples; how and when to demonstrate the product; the eye quicker than the ear; display boards; when to sell them and when to sell stock; missionary work; working with architects and contractors; how to "take off" a set of plans; how to make up a schedule; the use of stock articles versus the special orders.

Chapter X—Advertising and Dealer Co-operation. (By the Advertising Manager.) The "why" of advertising; what it is and what it is not; who pays for it; the cultivation of desire—selling in bulk; the legal value of advertising; protecting the trademark and building good-will; how our advertising is done; what its effect has been; how it is distributed; who sees it; how it reacts on the dealer; the use of advertising to open new accounts; to hold and expand old accounts; promoting sales by mail; value of home office sales

promotion work to salesmen in field; dealer co-operation; how to secure it; what we do for the dealers; classes of sales material supplied him; booklets, folders, cards, hangers, window displays, catalogs; how to teach the dealer to use these aids effectively; function of each kind of advertising; consumer attitude toward advertising; the triangle of manufacturer-dealer-consumer and how advertising cements the relationship.

Chapter XI—Credits. (By the Credit Manager.) Here the credit manager sets down clearly everything a salesman should know about the policies and workings of the credit department; terms to customers; new accounts; slow-pay, old accounts; O K'ing orders for credit; obtaining credit information; collecting overdue bills.

Chapter XII—Quotations, Discounts and Price Books. (By the Manager of the Price Department.) The principles of quotations based on the classification of trade and volume of business done; discounts in force; how determined; changing a customer's discount; special quotations; price book-making; reasons for list prices and discounts; salesmen's net sheets; how to use price book information most effectively in making up quotations.

Chapter XIII. Catalogs and the Stock Department. (By the Manager of the Stock Department.) What a catalog is; and what it is not; why certain articles are listed and others left out; reasons for stocking and cataloging products; building a catalog to suit the trade; how the stock department is organized; routing an order through the plant; filling orders from stock; from special order; necessity for proper classification and description of products on order; policy regarding partial shipments and supplementary orders.

Chapter XIV—Shipping, Invoicing, Claims Bureau. (By the Chief Clerk.) Methods of packing and shipping goods on order; insurance; f. o. b.; e. i. f.; charges prepaid shipments; pilferage losses; routing shipments to customers; partial shipments; charges on shipments; invoicing; methods of rendering bills; monthly statements; claims for breakage; for imperfect manufacture; warehousing claims; demurrage, etc.

Chapter XV—Salesmen's Correspondence, Reports, etc. Letters from salesmen to customers; to home office; order books; credit reports; advance notice postals; order for advertising material; expense accounts; general business reports; itinerary reports; comparative records of sales and sales quotas; how to get special information on products; on prices.

Chapter XVI—Studying Business by Graphic Analysis. This chapter consists of a brief explanation of the use of Babson charts, the Brookmire service, etc., and shows how statistical information may be studied by means of graphic charts. Included are some 20 charts specifically relating to the company's business, organization, growth, costs of production, advertising, and sales. These charts are of great value in giving the salesman statistical information in such a form that he can readily visualize its importance.

Chapter XVII—Dictionary of Hardware Terms. Since accurate definition removes many sources of misunderstanding, this chapter gives clear and concise definitions of every hardware term likely to be used by the salesman in describing or demonstrating a product or filling an order. It includes such words, for instance, as: bolt, gating, bower barff, bronze plated, spindle, strike, hands and bevels, mortise locks, extruded metal, etc.

Appendix—Thoughts from the Last Salesmen's Convention. Here is reproduced the gist of each salesman's remarks at the last convention, signed with his full name. This, on the theory not only that the salesmen always have something to say out of their past year's experiences that is worth while for the other salesmen to hear about, but that nothing will cause a man to read a book through, so much as the fact that some of his own signed stuff is in it.

Providing the Material

The foregoing material, concisely edited, following a logical scheme of presentation, and compiled in readily usable form, provides for "every-day in the year, the elements of an Annual Sales Convention". The only serious difficulty in building a similar manual for any other business lies in deciding what to leave out.

For there is never a lack of material which any man in the organization thinks ought to go in, and, unless great care is exercised, the volume will swell to a thousand or more pages, making it too bulky for the salesmen to carry with them, and thus defeating its purpose. Therein appears the need of a capable editor—a man who need not necessarily know the details of the company's business, but who must, perforce, be well acquainted with the many and devious ways in which the minds of salesmen work. Such an editor is a specialist in building sales manuals. Upon his shoulders is the responsibility for arranging the detail plan to be followed in forming the manual and for obtaining the material which it is to contain.

It is quite possible that very few organizations will wish to follow the exact methods which have been described but will desire a different presentation. In the work of formulating a plan which will fulfill the particular requirements of the situation and which will correlate the diverging ideas of the various interested executives the editor will prove most valuable. Because of this he must not only have a thorough understanding of selling methods and the way in which salesmen's minds work, but he must possess considerable knowledge regarding the proper ways to present material in order that it will gain the attention of the reader. And, possibly, the most important qualification of all, he must be able to arbitrate the differences of opinion which are bound to arise in regard to the quantity, the quality, and the method of presentation of the material to be placed in the handbook.

There is no doubt that a properly prepared sales manual is a great help to the selling force. It furnishes them with information regarding the company which they might not learn elsewhere, but which is sure to be of some assistance to them in preparing new sales arguments to meet the objections of prospects. The entire factory participates in its preparation and other departments gain an insight into the problems of the sales department.

Quantity Control of Inventories

Physical Regulation Contrasted with Mere Financial Information

By E. KARL WENNERLUND

Head of Department of Factory Organization, General Motors Corporation

Index Number
658.78 Material control

DURING the early days of the automobile industry it was taken for granted that financial control of material inventories was the best kind of control, and that by watching various sub-accounts the responsible executive would be able to keep his inventories within reasonable bounds. This idea prevailed until the beginning of the last decade, when it gradually gave way to what we may term *quantity control*. There were certain well-defined reasons for this change. One reason was the large amount of clerical detail which it was desired to eliminate. Another reason was the development of definite simple methods, whereby each *item* of material might be controlled as to purchase commitments and inventory.

At the time financial control of inventories was instituted, however, there was real need for something of that kind, because inventories were in bad shape; materials were being purchased often by judgment and guess; and individual items were far out of line compared with actual manufacturing requirements.

Financial Control Methods

Obviously, a mere inventory asset account would not furnish information for judging whether a specific purchase of material should be made, although it might indicate the relative standing of the total inventory as measured by past experience. Individual quantities might still be much out of line, greatly in excess of requirements on some items, very short on others. These conditions necessarily led to the classification of materials: (1) into broad divisions, such as castings, forgings, bar steel, lumber, leather, and so on; (2) into sub-classifications, namely, castings—gray iron, malleable, aluminum, brass. Each broad classification was given a key number, followed by a sub-letter or number for the detail. In addition, production material stores were also subdivided as a whole into raw, in process, and finished stores. Incoming material had to be identified as to its exact sub-classification, and its valuation debited to its account under the general heading of raw stores. Later, when the material was withdrawn, a requisition copy properly classified was sent to the accounting department, where it was priced, the sub-account given credit, and a corresponding charge made to Work-In-Process account. The balance in a sub-classification Stores account was expected to be a guide as to whether it was advisable to undertake further purchase commitments.

There is a vast difference between control and merely information. The above method was intended to give control, but what it actually did was to furnish information as to the amount of money invested in certain materials as a class. It might still be necessary to get into stock certain items, although the Inventory account for that classification showed in excess of any prescribed limit. What really governed in any particular case was the *quantity* of that material on hand measured against its future requirements.

Purpose of Inventory Control

Small concerns may go into systems of clerical analysis and tabulated information that later become impracticable, as the volume of business grows larger. It is our experience that the more freely material can move into and throughout a plant, unhampered by non-essential clerical detail, the more economically we can manufacture, and the larger will be the volume of production with a given equipment.

The way to have control of inventory, and its future commitments, is to control each individual item that enters into that inventory. If the quantity on hand, and the quantity still to come in, of each item, are right for a given manufacturing program, then the inventory as a whole must be right. It does not make it any more right to set up a lot of classified financial accounts. We determined, therefore, to see how far the pendulum might swing the other way, toward extreme simplification, and still not jeopardize securing accurate information essential for financial reports and balance sheets. It was found that we could go a considerable distance in that direction.

Classification of Inventory

Plant inventories covering consumable materials are of two main classes. One includes materials which enter directly into the product and are sold and shipped out to the customer. The other is made up of items which aid in getting out the product, and are essential to the operation of the factory, such as tools, lubricants, fuel, stationery, and general factory supplies. The first-mentioned class is termed "production materials". Items included in the second are carried under the general heading of "expense materials".

In our car unit plants, and nearly all accessory

* This is the sixth of a series of articles on "Tuning-up General Motors". Preceding articles have appeared in MANAGEMENT AND ADMINISTRATION for January 1924, p. 21; February 1924, p. 195; March 1924, p. 283; April 1924, p. 417; May 1924, p. 523.

plants, simplification has been carried to the point where stores requisitions for production materials are not sent to the accounting department at all. The book account for this class of material is charged with the amounts shown by accepted incoming invoices, plus freight, and is credited with the original value of materials when shipped out or placed in sales stores. The material value of all parts scrapped is also credited to this account and charged to factory overhead. The residue or debit balance of the account gives the asset value of all such materials in the plant available for the finished product. Still further, some of our plants operate entirely without the use of production stores requisitions or factory orders. The stores handlers merely keep a continuous supply of material in front of production lines. There are very few of our factories left where the worker on production has to obtain a job ticket, or have elapsed time kept on a job, or have a count made of pieces finished at his operation. The old factory order for obtaining direct labor costs is becoming a thing of the past.

The introduction of these methods has eliminated much costly clerical detail which formerly stood in the way of big volume production; and yet a very accurate control is maintained of materials purchased, of the amount of stores on hand, and of costs of parts and operation.

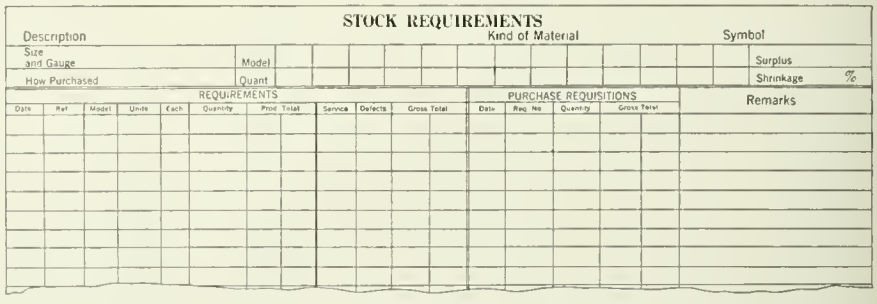
In the opinion of the writer, we could not today maintain the large volume production we do if our factories were again to be saddled with the detail factory clerical system that prevailed a dozen years ago. The two could not go together. Either the production rate would fall, or the detail would have to go.

The Control of Production Materials

There are two definite stages involved in the control of materials used for production. The first stage is purchasing. The right quantity of each item must be purchased, so that there is a minimum of leftovers to be ultimately scrapped or disposed of at a loss; conversely, the expense of getting in small quantities at the closing out of a production model must be avoided. Purchases must be made far enough in advance of actual production needs to permit the supplier to obtain his own raw materials and have them fabricated; transportation contingencies must be taken into account. The second stage concerns itself with receiving incoming material, its storage, disbursement to the factory, and disposal as finished product. This is the inventory stage—a liquid cash asset has been converted into an inventory asset. Naturally, the manufacturer wants to keep this item on his balance sheet down to the lowest possible point consistent with economical production. The two stages are entirely independent. We no longer buy with any reference to stock balances on hand. Materials are purchased and specified to come in at some future date, for newly acquired or future business. Materials that are already in the plant are intended for immediate manufacturing needs—for a quick turnover.

To facilitate the proper administrative control of materials, there are two departments organized for distinct purposes. One, the material-production department, specifies the quantities to be bought, and when to have them delivered to the plant. It records, stores, delivers, and handles materials. The other, the purchasing department, buys only on specification from the former department. It follows up deliveries, and gets materials to the plant. At this point its responsibility ceases.

The specifications covering the amount of production materials to purchase are on a purely mathematical quantity basis. They have no reference to financial accounts or to stock balances. The man who specifies quantities on purchase requisitions, with dates of delivery, does not see the stock balance record nor does he refer to the financial department for approval. He is dealing entirely with newly acquired business, or with estimated future business which has been duly authorized on a monthly forecast of requirements.


STOCK REQUIREMENTS

Description — Kind of Material — Symbol

Size and Gauge — Model — Surplus

How Purchased — Quant — Shrinkage %

REQUIREMENTS: Date | Ref | Model | Units | Each | Quantity | Prod Total | Service | Defects | Gross Total

PURCHASE REQUISITIONS: Date | Req. No. | Quantity | Gross Total

Remarks

FIG. 1 STOCK REQUIREMENTS CARD (11¾ x 9½ IN.)
Information contained on this card controls all material purchases.

To explain how this method functions in practice, we will consider a typical car unit plant whose product is sold in the form of finished automobiles and the incidental service parts. In such a plant there are from 2000 to 4000 distinct items of production materials purchased for current models, depending on the number of different models and body types being manufactured. Each item must be dealt with as a separate and distinct proposition. Hundreds of sources of supply located in various parts of the country are brought into direct working relations to furnish their highly specialized product. This may be leather, cloth, steel sheets or bars, lumber, paints, forgings, castings, etc., all needed for fabrication. Then there are specialized finished products such as ignition and starting devices, batteries, lamps, windshields, spark plugs, horns, tires; or partially fabricated items like frames and wheels. These materials are each specified by the engineering department for a given model. The specification list, or bill of material, gives the quantity of each item required for one finished unit. The number of units to be built of a given model, by body types, is definitely authorized by the general manager in charge of the plant. From time to time he issues additional authorizations as the market for the car develops. The material-production department then sets up a card called Stock Requirements (Fig. 1) for each distinct item of material to be purchased. This card carries no stock balances, but it absolutely controls purchases. It is handled merely as a debit and credit account dealing in quantities. On the debit side of the card are

entered the number of units authorized with quantities required. This is immediately offset by a credit entry recording the issue of a purchase requisition on the purchasing department. The total credits usually slightly exceed the total debits, to anticipate small scrappage or service withdrawals. When parts are scrapped through defects, or service orders are received, the quantities are entered as additional debits on this card.

It is evident that the requirement clerk merely needs to build up his debit totals for each item from authorized orders as they are received, and to build up his credit column by issuing requisitions on the purchasing department. He does not need to refer to stock balances or unfilled current purchase orders. If stock had been carried forward as an excess from a previous closed-out model it would be shown on the requirement card as an initial credit item. It is also evident that it would be useless delay and detail to refer a purchase requisition to the financial department for check or approval, because that particular item of material is actually required for authorized finished unit production.

There are plants making special parts or accessories of many sizes to fit the peculiar needs of a wide field of customers. Usually we cannot wait until the customer's order is received before taking steps to provide for materials with sources of supply. The customer's future needs must be anticipated so far as possible. This is done by means of a monthly forecast. The forecast sheet gives a summary of finished units as sold to customers. For each item or model it shows the total shipped to date, customer's unfilled orders in monthly columns of expected delivery, cumulative total orders, and total of previous forecast. With this information before him the general manager is in a position to make an estimate as to the number of units for which he will provide material, in anticipation of further sales orders being received. This constitutes the new forecast which immediately becomes authority to provide for materials. The additional units authorized by the forecast are broken down into component parts, by referring to engineering lists of material. The quantity of each item required is computed, then entered on its requirement card and covered by purchase requisition. Where this method prevails, customer's orders may come in daily or at least several times during the month. In order to know at once the relation between orders received and material purchased for each item, it is the practice to enter customer's orders when received as debit items on the card, and the monthly forecast as credits. This automatically provides means for purchasing during the month should it become necessary, because when orders come in faster than estimated by the forecast, the debit total is built up to exceed the quantity previously purchased. Thus an additional purchase requisition is made at once, instead of waiting for the next monthly forecast. This method has been a great help to plants having to provide for materials in advance of numerous customer's orders. The card shows positively how material commitments stand as to quantity, without the necessity of reverting to exhaustive analyses of stock balance records.

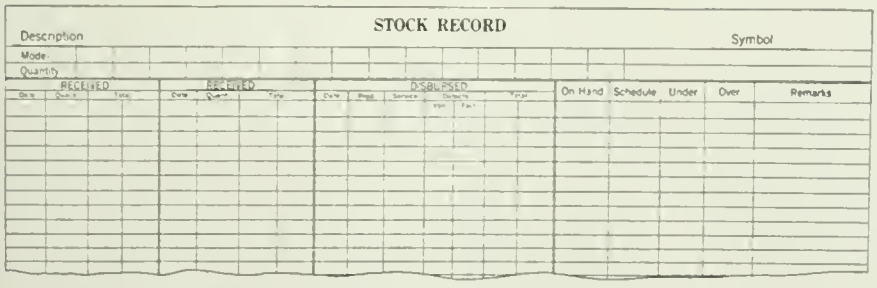


FIG. 2 STOCK RECORD CARD (11¾ x 9½ IN.)
Gives information regarding the plant inventory but does not influence purchases.

Scheduling of Purchase Orders

The time when material should arrive at the plant is indicated on the purchase requisition and transcribed on the purchase order sent to the supplier. These dates are arrived at by discounting the authorization or forecast schedule. Raw materials to be fabricated usually arrive two months before the finished unit leaves the factory, and finished small materials 30 days before. The relatively few expensive and large parts are scheduled specially, often governed by storage facilities. The length of time to carry materials before they are again converted into finished units will vary according to local conditions, such as distance from supply markets, transportation contingencies, storage facilities, time required for processing, and so on. The aim is, of course, to carry as little as possible and still avoid delays to production. Even so, much material has to be carried 60 days for safety, and in some cases 90 days. An average inventory turnover of six or eight times a year is considered good.

So far as inventory financial figures are concerned, materials need not be scheduled for specific dates during the month, although storage facilities for bulky material may in some cases make that necessary. It is the usual practice in the trade, for invoices received during the month, to be paid on the tenth or fifteenth of the following month; and, as financial balance sheets are made out as of the last day of the month, it does not make any difference from that standpoint whether an invoice is dated on the second of the month or on the twenty-eighth. Hence, no fine-haired methods of scheduling are resorted to. If storage space permits, it is advisable to have materials arrive early in the month for which they are scheduled to avoid possible delay.

Control of Inventory

We have seen that materials are purchased ahead for anticipated future business; that under this method the actual stock balances on hand do not control purchases. The full quantity of any kind of material specified for delivery may be in the plant, or only a part of it may have been received, it is all the same so far as future buying is concerned. But it is necessary

to keep check on the available quantity in the plant. It is even more important to avoid running short of a few items than it is to maintain the minimum inventory. A shortage on a single one of several thousand kinds of materials may be disastrous by tying up the entire factory output. On the other hand, certain materials may be coming to the plant in larger volume than desired, tending to build up an unwieldy inventory. The method of monthly forecasts, estimating the business three to five months ahead, and specifying delivery of materials a suitable period in advance of these estimates, becomes in itself a very effectual check on the incoming volume. In addition thereto, however, it is essential to know the plant stock balances on every item, in order to exercise the desired detail control, and particularly to guard against material shortages arising during the current month's operations.

A simple and effective quantity control has been developed whereby it is unnecessary to compute stock balances except at the close of each month, although such balances may be obtained as frequently as desired. This has led to the elimination of stockroom records or balances, except for bar stock or sheets making a variety of parts. Obviously, if the material is in the plant, available for final production, it does not make any difference, so far as material control is concerned, where it happens to be. Whether it is in raw stores, in process, finished stock, or parts assemblies, the plant balance remains the same. When a part, other than bars and sheets, leaves the storeroom and goes into production, it does not affect our material records, but is handled under Production Control. The two sets of records are kept entirely separate and distinct, which is one of the main reasons why we have been able to simplify to such great extent the handling of materials in the storerooms.

FOR MONTH OF _____ MATERIAL FOLLOW-UP RECORD
MR _____

Part No	Name	Quantity on Hand	Quantity Required		In Transit C END	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	29	30	31
				Shipped																			
				Received																			
				Tot Rec'd																			

FIG. 3 MATERIAL FOLLOW-UP RECORD (20 x 12 IN.)
Used by the material expediter to keep informed of the status of his work.

RECEIVED FROM _____ RECEIVING SLIP. NO. P 106
Date _____ 192_
Received Via _____ Car { Initial _____ Number _____
Pro. No. _____ Amt. Charges _____
No. Boxes, Pkgs., etc _____ Weight { Gross _____ Tare _____
Frt. Ext. on Rec. Sheet Nos.

ORDER NO.	QUANTITY	PART NO.	DESCRIPTION	NET WEIGHT

QUANTITY O. K. | QUANTITY REJECTED | INSPECTOR
Why Rejected? _____
Deliver to _____ Signed _____
Receiving Dept.

FIG. 4 RECEIVING SLIP (8 x 5 IN.)
Issued in quadruplicate by the receiving department and forwarded to the storeroom and other interested departments.

Follow-up of Purchase Orders

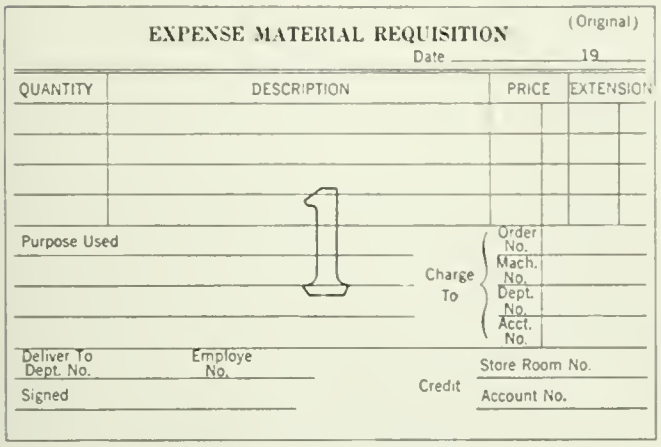
The follow-up of purchases remains in the hands of the purchasing department, which gets the material to the plant. When we consider the many kinds of parts to come in at an automobile or accessory plant during the month, from hundreds of sources of supply, it is evident that the subject cannot be left to chance. Emergency shipments, telegrams, and long-distance calls must be avoided wherever possible. Yet it is impracticable to leave the stock balance records in the hands of the purchasing or follow-up section, due to factory adjustments, such as scrappage, service withdrawals, or substitution of materials. The responsibility for total quantities purchased and inventory volume must rest with the factory operating staff.

A simple method of plant inventory control is shown by Figs. 2 and 3. On the stock record are entered the daily receipts of each item as reported by the receiving-room on the Receiving Slip (Fig. 4). These quantities are merely accumulated in the total column. Under the general heading of Disbursements is entered material leaving the factory, including finished units delivered to sales stores. Service withdrawals, or defective material scrapped, are entered under disbursements as they occur; but regular production in the form of finished units is broken down into component parts at the close of each month, and then disbursed item for item. The difference between the total receipts and disbursements gives the plant stock balance. As previously pointed out, this balance does not influence purchasing, which is controlled from the Requirement Card (Fig 1). It is used merely for information, primarily to find out how we stand in relation to the following month's schedule of receipts. The stock record also becomes a history of the plant inflow and outflow of any specific item of material, should it become desirable to make a detail check at any time. In the final analysis, if the right quantity is purchased for a given production program, and adjustments made for materials diverted to service sales or scrap, or for emergency substitutions, then we are certain to come out right when all manufacturing orders have been completed.

It will be noted that the Stock Record Card (Fig. 2) is provided with a column for the plant schedule. This is the gross quantity of that particular item of material required for production during the coming month. It is computed from the month's actual manufacturing schedule plus any desired period ahead, usually two weeks to 30 days, depending on local conditions. That is, the gross quantity scheduled would leave us at the end of the month with an extra supply to swing pro-

duction for part or all of the following month. But when this schedule, as to gross quantities, is computed there is already a balance of stock available in the plant of possibly every item; hence, only the difference between the gross and the balance available should be received. This quantity is shown in the column headed "Under." The "Over" column indicates that a larger quantity is already on hand than required by the manufacturing schedule, and that none should be allowed to come in during the month if it is practicable to stop sources of supply.

The information as to quantities due for the month is listed on a Material Follow-up Record (Fig. 3),


EXPENSE MATERIAL REQUISITION (Original)

Date _____ 19____

QUANTITY	DESCRIPTION	PRICE	EXTENSION

Purpose Used

Charge To — Order No. / Mach. No. / Dept. No. / Acct. No.

Deliver To Dept. No. _____ Employe No. _____

Signed _____

Credit — Store Room No. _____ Account No. _____

FIG. 5 EXPENSE MATERIAL REQUISITION (6 x 4 IN.)
Issued in triplicate for withdrawal of expense material from the storeroom.

properly classified and turned over to the purchasing department, follow-up section. A separate overage report is listed to show materials which should be held up if convenient to do so. The Follow-up Record form is used as a working sheet on which are entered invoice advices of shipments, and actual receipts from copies of receiving slips. It gives the follow-up man definite, concise information for each item of material required, showing just what is the plant stock balance and the additional quantity to get in during the month.

Physical Handling of Materials

With the latest development in handling materials after they have been received in the plant, stockroom bins have been eliminated. The material is checked over when received, inspected, and counted (by computing scales for small items), then placed in standardized containers wherever these will apply. A predetermined quantity is placed in each container, which is moved by conveyor truck to the stockroom. Here the containers are piled up in order to save floor space. Delivery to the factory is made by container, which saves recounting.

Wherever the factory is arranged for continuous production on certain parts, the finished stock is not again taken to a stockroom, but is delivered directly to the assembly line. In such cases no requisitions are made on the storeroom for production stock, nor is any record kept of the number of parts produced. Production is controlled by merely keeping the line full, and maintaining a *bank* of finished parts at the end of the line. The foreman is advised of the expected production rate for the month, so that he can arrange his man-power accordingly. The quantity of finished parts maintained in this bank is the best possible control of his production rate, as he must maintain that surplus at all times; and, on the other hand, he is not allowed to build it up unduly.

For intermittent production, that is, where primary machines or production lines change from one part to another, the manufacturing schedule is computed and controlled from the material-production office. The control is entirely for the primary machine, no record being kept of quantities completed. Parts spoiled or found defective are replaced by issuing an equivalent quantity to the primary operation, or by addition to the following month's schedule. Just how production planning has gotten down to a very simple and effective basis, entirely by quantity control, will be told in a future article on this subject. Suffice it to say, that we do not mix material records and production records. Some materials make a variety of finished parts; others need no further processing whatever, but enter directly into finished assemblies. To keep the two records separate has given the opportunity for much simplification.

Expense Materials

Since we have dealt in some detail on the control of production materials, a few words should be added regarding the maintenance of supply stores—those items which are necessary to keep the factory going, but are wholly consumed within the factory. A recent survey in one organization revealed 3000 distinct items of supply stores, each one of which has to be maintained in stock constantly. These include drills of various kinds and all sizes, reamers, cutters, abrasives, hand tools, measuring instruments, lubricants, and millwrights' supplies of many varieties, down to brooms, buckets, soaps, and paper towels. Each one of these items is presumably necessary and has been duly authorized to be carried in stock. The list has been carefully standardized so as to bring the different kinds down to a minimum. All such supplies are carried first in a central storeroom, if it is practicable to place them there; or they are stored under the supervision of the storekeeper.

The money value of such stores is carried as an asset on the general books until a signed Expense Requisition (Fig. 5) is received making a withdrawal. The requisition is priced, its value credited to expense material stores, and a charge made against a departmental expense account. Thus, when a standard tool leaves general stores it is no longer carried as an asset, but is immediately charged off and absorbed into the plant overhead, although that particular tool may long afterwards be in use.

That brings us to the point of the control of supply stores. This is done by setting up a card for each item. An authorized minimum and maximum to carry is entered on each card, based on experience and judgment. As supplies are ordered, received, and disbursed from stores, entries are made and a balance maintained. When the minimum is reached a summary is drawn off

the card showing when last ordered, quantity disbursed, and quantity required for maximum. This information is reviewed by the storekeeper and a purchase requisition placed accordingly.

It is quite obvious that the only control that counts in this case is one based on quantity, not on finances. Either a particular item is needed, or it is not. If it is needed, there is only one common-sense thing to do, and that is to go ahead and buy it. Of course, allowances may be placed on departmental *consumption* of supplies—sometimes called a budget—which is merely for the purpose of comparing actual expense with an estimated standard; or, it may offer an incentive for a department head to watch his supply expenses much closer. That this is not really a budget is evident from the fact that if a foreman needs certain supplies, he gets them, regardless of what the figures show. However, standardized allowances for expense materials, based on experience, are useful as a means of checking extravagance and of inducing thrift. Regardless of this, the supply stores balances are maintained by quantity count.

A plant of large volume production has also a large working force. It must maintain a supply of usable materials sufficiently ample to keep that force constantly busy, and to swing production through all its stages. Provision must be made to guard against shut-downs from unforeseen contingencies, or from interruption to transportation. The entire factory staff should be able to report for duty every working day, and to be under high pressure production demands. Nothing is more demoralizing to a factory organization than to have intermittent shut-downs due to lack of material supply. Consequently, a liberal inventory of each item must be carried. The money value of such materials at individual plants runs into millions of dollars. On the other hand, inventories must be kept to the lowest figure consistent with operating safety. These, therefore, have to be controlled.

But, in the final analyses, the only effective control is that of the individual item. No attempts at mass control will keep the factory operating. It is just as important, if not more so from an operating standpoint, to keep the control upward toward an ample supply, as to have its tendency downward to an ideal minimum. Factory shut-downs are much more expensive than the interest on inventory investment. The important thing is to buy exactly the right quantity of each item, then get it in so as to have it available, but not to have it accumulate so far ahead that it gets shopworn, or that it becomes a problem where to have it stored.

Item for item, it is not at all difficult to determine just how far ahead of final unit production material receipts should be. The control is instituted merely to carry out these common-sense ideas. The simpler the clerical work incident to that control can be, the better it will function. In putting these ideas into effect the past few years, we have found that we are able to swing a large production with a surprisingly small amount of clerical detail, and at the same time have our information up to date so that it is usable. More important, it is very seldom, indeed, that our factories have interruption to their steady daily scheduled production due to material shortages; neither do we have to throw excess parts away at the end of a production program. The real test of a material system is to keep the factory operating with the least wastage and expense, and our system satisfies both these requirements.

Experimental Equipment Mounted on a Portable Table

Index Number
658.28 Service equipment

AT the Emeryville plant of The Paraffine Companies, Inc., the Technical Research Department has in operation a portable table equipped with small scale experimental equipment for research work on paper pulp, paint, roofing, and other products which the company manufactures.

The table on which the experimental equipment is mounted can easily be moved to any part of the room and even taken out of the room, if necessary, without disturbing any of the apparatus mounted on it. From Fig. 1 an idea of the completeness of this outfit may be obtained.

At the back of the table is a small motor which drives an overhead line shaft. This, in turn, drives the various machines. At the right of the table is a small crusher for breaking up rock and mineral matter. To the left of the crusher is a vacuum pump used for general experimental work. In the center of the table is a beater and to the left of this is a mixer. At the extreme left is a miniature sulphite digester for making sulphite pulp, used in making the highest grade of pulp paper.

It is important that the chemical and physical properties of materials made by this company meet all the particular requirements of the services for which they are designed. In the development of these products the adaptability of the portable table has simplified the work of research.

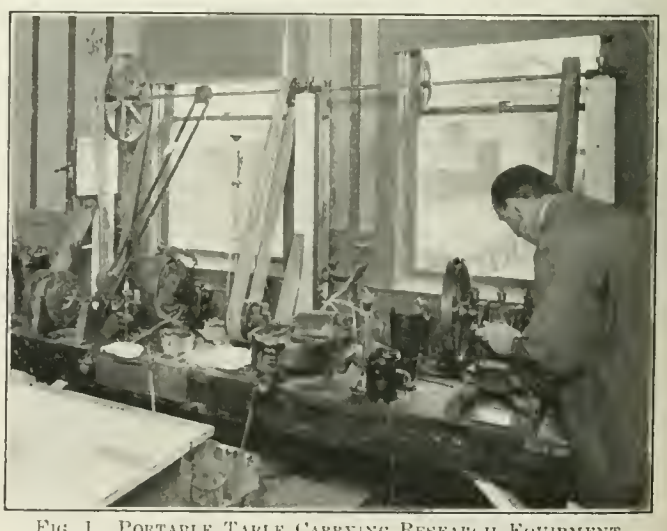


FIG. 1 PORTABLE TABLE CARRYING RESEARCH EQUIPMENT

Distribution of Overhead to Jobs

Profitable Methods for the Small Factory—V[1]

By GEOFFREY C. BROWN

Chief Engineer, Jacques Kahn, Inc.

Index Number
657.441 Overhead expenses
658.5:657 Shop accounting

THERE is no principle of modern management more fundamental to the success of a business than that of cost finding. Small manufacturing concerns that have not established some form of cost system must have recourse to the general books in order to obtain information as to the financial position of the business at any given time. While these books show, in a cumulative way, the expenditures for material, labor, and overhead, they do not show any details as to *how* and *why* these expenditures were incurred. Also, while a statement drawn from the books may indicate quite accurately the general status of the business, it will fail utterly to provide an economic comparison between different articles or lines of product, different manufacturing methods, or different operations. As the ultimate success of a manufacturing enterprise must depend upon its ability to produce *profitably*—presupposing the existence of a means for knowing, in terms of the product and of processes, whether this is being done—some form of cost system, supplementary to the general books, becomes a necessity.

As with the other planning functions, the problem of adapting a cost system to the small factory is largely that of attaining a proper degree of simplicity, concentration, and economy of detail. The elements which combine to form total manufacturing cost are those that would appear in a plant of any size. Overhead expense must be distributed, and direct labor and material costs recorded, in terms of each of the manufacturing orders that pass through the factory during the course of a month. To do this effectively, and at the same time avoid the creation of a system that will ultimately prove cumbersome, is the problem which confronts the small factory manager.

Distribution of Overhead Expense

An important preliminary stage in the installation of a cost system consists of the distribution by some means of that intangible and, as a rule, somewhat bothersome part of total cost usually termed overhead expense. The proper allocation of this expense is undoubtedly the most complicated and difficult phase of cost accounting. This article will, therefore, be devoted largely to the subject of overhead distribution and its adaptation to the problems of a small manufacturing organization. A subsequent one will discuss the actual recording of monthly costs on shop orders as they pass through manufacture.

The various elements which together comprise total manufacturing costs are shown graphically in Fig. 16. The cost amounts corresponding to each element have illustrative value only and should not be regarded as representative of any specific industry.

Elements of Manufacturing Cost

It will be observed that in the two lower divisions of the diagram the elements of material (meaning direct or productive materials) and of direct labor appear, and that the sum of these two elements comprises what is termed "Prime" or sometimes "Flat" cost.[2] If a small organization is in possession of adequate stores-keeping and timekeeping methods, little difficulty need be experienced in allocating quite accurately to customers' orders the proper amounts of these two elements that each should bear. The stores-inventory cards will show material costs, and the Workman's Production or Job Cards the direct labor amounts chargeable to each.

The element of indirect or factory expense lies in the section immediately above those of direct material and labor, the sum of all three elements forming what is termed factory or shop cost. Indirect expense includes all features of factory cost which cannot be directly expressed in terms of each of the various orders passing through manufacture, but which gather in clouds of varying density about all the orders. Among these are indirect labor, including trucking, oiling, janitor service, etc., indirect material or supplies such as small tools, lubricants, brooms, trucks, etc.; the cost of power consumed either by factory motors or for heat and light; expense incidental to the depreciation and maintenance of manufacturing equipment; the cost of factory supervision, etc. These features together with a proper proportion of the more fixed expenses of floor space rental, insurance, and taxes are indirect but very real components of factory cost, and therefore must be distributed in such a way that customers' orders will individually bear a fair and proportional amount of each.

Proper allocation of this expense, obviously, cannot be accomplished directly as was the case with direct material and labor costs, and it cannot, as a matter of fact, be distributed with *exactness* by any method so far devised. There are, however, a number of

[1] Preceding articles have appeared in MANAGEMENT AND ADMINISTRATION, February 1924, p. 161; March 1924, p. 305; April 1924, p. 431; May 1924, p. 567.

[2] MANAGEMENT AND ADMINISTRATION for March 1924, p. 305.

methods by which an approximate distribution, close enough for practical purposes, may be effected. These will be discussed in some detail.

Above indirect expense in Fig. 16 will be found a division representing expense which is incidental to administration of the business as a whole, but which cannot be specifically related to either manufacture or selling. Expense of maintaining the accounting, pay-roll, purchasing, receiving and shipping departments, and the salaries of officers, are typical features of administrative expense.

The remaining element, that of selling expenses, appears at the top of the diagram below the profit division. Included here are usually found all expense features directly connected with the sales department, such as commissions, discounts on sales, advertising expense, sales, clerical expense, and frequently the freight and express expense incidental to transportation of the product to the customer.

Compiling Indirect Expense from the General Books

Before proceeding further, it might be well to emphasize the fact that the term indirect expense, as employed throughout this article, refers only to factory overhead (Fig. 16) and must be regarded as quite distinct from administrative or selling expense, the character of which has just been described.

The preliminary stage in effecting a proper distribution of factory overhead must necessarily consist of compiling it in gross amounts from the general books, over a definite period of time. The interval spanned by the preceding year will usually be found a convenient one for this purpose. A classification of the various constituent items that enter into this expense, together with the general sources from which corresponding figures may be obtained, will, in the majority of small plants, be substantially as shown in Table 1.

The total expense corresponding to each of the above items, over whatever period is chosen—say the previous year—should be assembled and segregated as far as possible by factory departments. This can be accomplished readily with some of the items such as indirect labor, factory supplies, maintenance, repairs, depreciation and supervision. In these cases, either the books will definitely indicate the department in which the expense was incurred, or the individual entries will evince some characteristic that clearly connects the expense with a specific department. In order to distribute power cost to departments, the best and most accurate method lies in the installation of power-consumption meters, and the measurement, by this means, of the electric or steam power actually used by each department over a definite period of time. A perfunctory distribution of electric power is sometimes effected by totaling the indicated horsepower of all motors throughout the factory, and then distributing the total power cost to departments by horsepower ratio. The total expense of light, heat, rent, insurance, and taxes, may be distributed to departments in proportion to the floor space areas occupied by each, the latter being a readily ascertainable factor.

One variety of indirect expense can now be proportioned in such terms that it may be very simply allocated to shop orders, this being the expense of storing and moving material, variously known as storeskeeping expense, stockkeeping expense, or material loading. The total expense segregated to this department is best expressed as a simple percentage of the total material cost over a corresponding period. This percentage then becomes the proportion that must be added to the material cost of shop orders so that each may bear its proper share of stockkeeping expense. For example, if direct material cost during the previous year was $20,000, and the stockkeeping expense over a similar period was $2,000, by this method $\frac{\$2,000}{\$20,000}$ or 10 per cent, must be added to the material cost of each shop order to provide for the expense of stockkeeping and all its incident operations.

TABLE 1. CLASSIFICATION OF VARIOUS ITEMS THAT ENTER INTO INDIRECT EXPENSE, TOGETHER WITH GENERAL SOURCES FROM WHICH CORRESPONDING FIGURES MAY BE OBTAINED

INDIRECT EXPENSE ITEMS	SOURCE FROM WHICH TO OBTAIN GROSS FIGURES
1. Indirect labor	Previous pay-rolls.
2. Factory supplies	General books.
3. Power, light, and heat	Fuel and other accounts on general books.
4. Maintenance and repairs	Accounts covering repairs, etc., on general books.
5. Depreciation	General books and, if necessary, last official appraisal record.
6. Rent	Rental account on general books.
7. Insurance	General books—Record of premiums paid during year.
8. Taxes (not including income tax)	Tax-payment account on general books.
9. Supervision	Previous pay-rolls for salaries of superintendent, foremen, gang bosses, etc.

Methods of Distributing Indirect Expense

There are, in common use, a number of methods for the distribution of departmental expense, and while these differ in their manner of application, they may all be said to rest on the same basic principle. It has been seen that the difference in character between prime cost and indirect expense lies in the relative intangibility of the latter. In order to distribute this expense, therefore, it must first be related to, and expressed in mathematical terms of, some tangible element in manufacturing cost. When it has been so related and so expressed, it may be allocated to each shop order in terms of this relationship. It is apparent that the cost of direct labor and direct material are tangible elements in the manufacturing cost of an order. Another tangible element, readily susceptible to direct measurement, is the time in hours spent by men or machines in the accomplishment of each manufacturing process through which the order must pass during its journey from raw material to finished product. Based on this reasoning, then, the important methods of distributing factory overhead are found to be as follows:

1. Distribution as a percentage of direct labor cost.
2. Distribution as a percentage of direct material cost.
3. Distribution as a percentage of prime cost.
4. Distribution by machine hourly rates.

The first of these methods, distribution as a percentage of direct labor cost assumes that the indirect

expense involved in the manufacture of a shop order, varies directly with the direct labor expended on the order. Suppose, for example, that over a certain period of time the expenditure for direct labor in a factory or manufacturing department amounts to $5,000. Suppose, further, that the total indirect expense during the same period is $7,500. The amount of indirect expense which each shop order must bear, is by this method $\frac{\$7,500}{\$5,000}$ or 150 per cent of its direct labor cost.

The second method, distribution as a percentage of direct material cost, assumes that indirect expense varies directly with the cost of the direct material entering manufacture. Using again the example of the preceding paragraph, with an added assumption that the material cost is $3,000, the amount by which the cost of each order must be increased, in order to provide for indirect expense, is found to be $\frac{\$7,500}{\$3,000}$ or 250 per cent of its direct material cost.

The third method, distribution as a percentage of prime cost, assumes that indirect expense varies directly with prime cost. Thus, again making use of the preceding data, the percentage to be added to the cost of each order will be $\frac{\$7,500}{\$5,000 + \$3,000}$ or 93 per cent of its prime cost.

It is clear from an examination of each of the foregoing methods, that total indirect expense may be distributed, with some approach to accuracy, by any one of them. They are all, however, averaging methods, concerned more with an absorption of total factory overhead by the law of averages, than by allocation to each shop order of the approximate proportion of expense that it has incurred and should rightfully bear. If a business is simple in character, turning out a single line or a few uniformly similar lines of product, factory expense may usually be distributed in this way. This is not due to special accuracy in the method but is more because, as each line of product is making approximately the same use of all factory facilities, an average distribution of expense is all that is required.

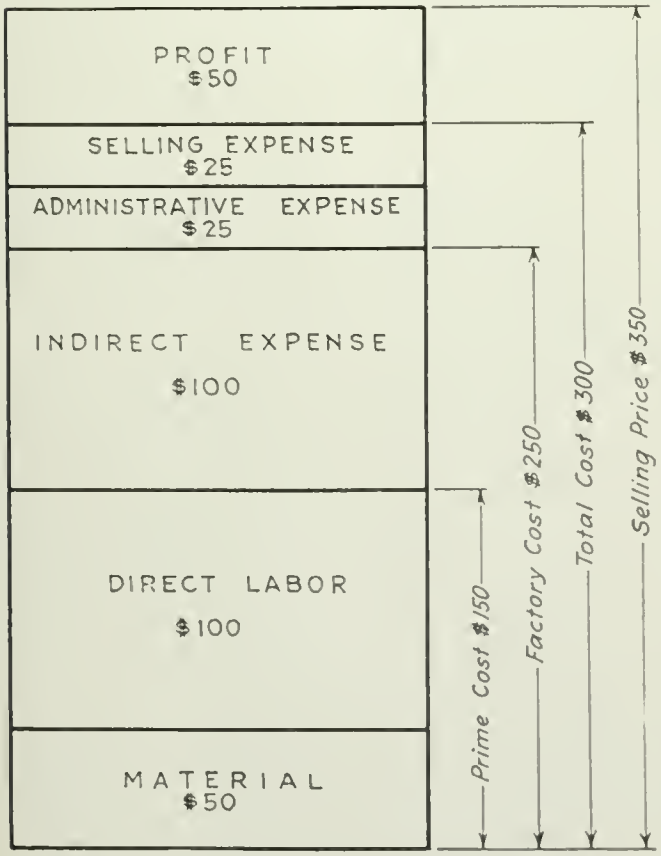


FIG. 16 ELEMENTS OF TOTAL MANUFACTURING COST

In a general way, all of these plans fail utterly in cognizance of the fact that overhead expense is not incurred, in uniform degree, by each of the productive activities. Assume, for instance, that a mechanic employed at a work-bench and using a few simple tools, receives a wage of 80 cents per hr. Assume, also, that in the same department the operator of a large hydraulic press is paid at a similar rate. If indirect expense be distributed as a percentage on the labor cost of both these operations, the overhead cost of running the large press with its heavy power consumption, high maintenance cost, and high floor space rental becames identical with that of the relatively inexpensive bench operation. This example is sufficiently typical to illustrate the defects inherent in each of the plans of expense distribution so far described.

We come now to the fourth method, or distribution by machine hourly rates. It has been observed that in each of the preceding plans, indirect expense was distributed over the entire product, sacrificing thereby any connection with individual processes or machines. Yet there is little actual connection between most of the overhead features and the direct labor or material costs which were made the bases of this distribution. The fact is that nearly all items of factory expense gather about productive operations and machines, and could be said to vary in approximate proportion to diversities in the character of these productive stages. Fixed expense, like rent, insurance or taxes, has no connection with the cost of labor or material because this expense is incurred continuously whether a plant be active or idle. Depreciation expense, maintenance expense and power cost are obvious attributes of individual machines. This is also true, though perhaps to a lesser degree, of indirect material or supplies, and it is abstractly true of the expense of supervision. It is logical, then, to infer that in order to obtain an equitable distribution of factory overhead, it must be apportioned to machines or processes by some system of rating that will tax each of these with a fair proportion of the total expense incurred by all.

The Determination of Machine Hourly Rates

The conception advanced by A. Hamilton Church,[3] which treats a factory as an aggregation of "production centers" or "little shops," would seem the best possible one from which to approach the problem of distributing factory expense through machine hourly rates. A little shop, as so conceived, consists of a machine or work-bench, and must be regarded as a complete producing unit, quite distinct from any other pro-

[3] "The Proper Distribution of Expense Burden," and "Production Factors in Cost Accounting and Works Management."

ducing unit. Viewed thus, each little shop will conduct its own particular industry, pay for the power that it uses, for repairs, for depreciation of its equipment, pay rent for floor space and interest on the capital invested, and will do so quite independently of any other producing unit in the factory. These little shops will naturally vary in size and character depending on the type of productive activity in which each is engaged, and as they are all active through varying periods of time, the simplest way of computing and applying their monthly expense will be on a time basis of so much per hour.

It is clear that if the indirect expense of maintaining each of these small shops, or machines as we will now call them, be calculated into terms of an hourly rate, the cost in factory overhead incurred by a shop order that passes through any or all of them may then be readily determined by multiplying the actual hours during which each machine has been engaged on the order by the corresponding hourly expense rates, and then adding together all the products so obtained.

The procedure to be followed in determining machine hourly rates, and the degree of minuteness with which it is desirable to distribute expense to individual machines, will be controlled very largely by the character of each specific industry, and the relative uniformity with which the various overhead features bear on each producing unit. If the latter differ widely in size and individual characteristics, it may be necessary to segregate the actual expense incurred by individual machines. In the majority of small factories, there is enough uniformity in the equipment to render such minuteness unnecessary, and a sufficiently accurate result will be obtained by a preliminary distribution of expense to departments, its subsequent reduction to an hourly basis, and the final distribution of this hourly expense to machines proportionately to their floor areas. Under these conditions, the work of establishing machine hourly rates may be subdivided into three progressive stages of operations, as follows:

1. Consists of compiling from the general books, old pay-rolls, and other general sources earlier described, the total indirect expense amounts corresponding to each element of factory overhead for the previous year. Table 2 shows a convenient form in which this expense may be compiled and tabulated by factory departments.
2. Consists of reducing the departmental expense shown in Table 2 to a set of hourly expense factors, one for each element of indirect expense. This reduction may be accomplished by dividing the expense amount corresponding to each element by the working hours represented. Thus, since the yearly indirect expense in Department DP (Table 2) amounted to $11,140, and the corresponding yearly hours that the department worked were 2,235, the hourly expense factor becomes $\frac{\$11,140}{\$2,235}$ or $4.99. Table 3 shows a tabulation of hourly expense factors arranged in the same departmental order as are the annual expense amounts in Table 2.
3. Consists first of taking careful and detailed measurements of the total floor area of every factory department, and of the total floor space occupied by each machine or producing unit. In making this survey it must be borne in mind that the productive area occupied by a machine includes, in addition to the floor space upon which it actually stands, at least 2 ft. of additional working space for the operator to move about in. Also that the non-productive areas taken up by aisleways, toilet-rooms and shop offices, etc., in each department, must be measured separately, and the sum of this space redistributed proportionately over the productive space occupied by machines. When these measurements have been made and tabulated, the sum of the hourly expense factors shown in Table 3 may then be distributed over all producing units in the exact proportion that the floor space occupied by each bears to the total areas

TABLE 2. FIRST STAGE IN THE DEVELOPMENT OF MACHINE HOURLY RATES[1]

EXPENSE ELEMENTS	DEPT. A	DEPT. D. G.	DEPT. D. C.	DEPT. D. M.	DEPT. D. P.	DEPT. D. S.	TOTAL
Indirect labor	$00,000	$0,000	$0,000	$0,000	$4,450.00	$0,000	$00,000
Expense supplies	0,000	000	00	000	170.88	0,000	0,000
Power	000	000	00	000	545.04	0,000	0,000
Maintenance and repairs	00	000	000	0,000	600.00	00	0,000
Depreciation	0,000	000	00	0,000	300.08	0,000	0,000
Rent	0,000	0,000	0,000	0,000	960.00	0,000	00,000
Insurance	000	00	0	000	145.00	000	000
Liability insurance	000	000	00	000	300.00	000	0,000
Taxes	00	00	00	000	55.00	00	000
Supervision	0,000	0,000	0,000	0,000	3,614.00	0,000	00,000
Totals	$00,000	$00,000	$00,000	$00,000	$11,140.00	$00,000	$000,000

[1]This table shows indirect expense compiled by departments for the preceding year. Actual expense amounts for one department (Dept. "D. P.") are reproduced from the files of Jacques Kahn, Inc.

TABLE 3. SECOND STAGE IN THE DEVELOPMENT OF MACHINE HOURLY RATES, SHOWING THE YEARLY DEPARTMENTAL EXPENSE IN TABLE 2 REDUCED TO A SET OF HOURLY EXPENSE FACTORS, ONE FOR EACH ELEMENT OF INDIRECT EXPENSE

(i.e., $\frac{\text{Yearly expense}}{\text{2235 Yearly hr.}} = \text{Hourly expense factor}$)

EXPENSE ELEMENTS	HOURLY EXPENSE FACTOR DEPT. A	HOURLY EXPENSE FACTOR DEPT. D. G.	HOURLY EXPENSE FACTOR DEPT. D. C.	HOURLY EXPENSE FACTOR DEPT. D. M.	HOURLY EXPENSE FACTOR DEPT. D. P.	HOURLY EXPENSE FACTOR DEPT. D. S.	TOTAL
Indirect labor	$0.000	$.000	$0.000	$.000	$1.991	$ 000	$00.000
Expense supplies	.000	.000	.000	.000	.076	.000	0.000
Power	.000	.000	.000	.000	.244	.000	0.000
Maintenance and repairs	.000	.000	.000	.000	.269	.000	.000
Depreciation	.000	.000	.000	0.000	.135	.000	.000
Rent	.000	.000	.000	.000	.430	.000	0.000
Insurance	.000	.000	.000	.000	.065	.000	.000
Liability	.000	.000	.000	.000	.135	000	.000
Taxes	.000	.000	.000	.000	.025	.000	.000
Supervision	0.000	.000	.000	.000	1.629	.000	0.000
Totals	$0.000	$0.000	$0.000	$0.000	$1.990	$0.000	$00.000

of the department. Tables of Machine Hourly Rates similar to those reproduced in Fig. 17, may be thus prepared for each manufacturing department.

This, in brief, is the plan of distributing indirect expense by machine hours, a method which in its present development, seems the most logical and most accurate way of allocating factory overhead. When hourly expense rates have thus been established for every machine in a factory—and the term "machine" employed in this sense can include such simple equipment as a workbench, a vise, or a grindstone—these rates may be as simply applied as are workmen's wage rates. When multiplied by hours of elapsed time, they give, in a single operation, the direct labor cost of each manufacturing order.

Those features of expense which are incidental to administration of the business as a whole, such as the cost of maintaining the accounting, pay-roll, purchasing, and other clerical departments, are, as stated earlier, usually combined under the name of "Administrative Expenses" (See Fig. 16). It is extremely difficult to relate this expense to shop orders or to productive processes by any known method of allocation. It is customary, therefore, to distribute administrative expense as a percentage on Factory Cost (direct labor plus direct material plus indirect expense), after the latter has been properly determined. For example, if the factory cost for the previous year is found to have been $400,000 and the administrative expense during a similar period was $100,000, the percentage by which the factory cost of each shop order must be increased in order to provide for administrative expense, will be $\frac{\$100,000}{\$400,000}$ or 25 per cent. Thus, if the factory cost of a shop order is $160, its administrative cost on this basis will be $40, which must be added to the former figure, giving $200 as the total manufacturing cost of the order.

Selling expense which includes all items connected with the sales department, such as commissions, discounts on sales, advertising expense, sales clerical expense, etc., is likewise difficult to distribute proportionally to the product or to manufacturing processes. As commission is almost invariably paid in the form of a percentage on the sales value of orders, this feature may be readily provided for by adding commission amounts directly to the cost of each customer's order. This method also holds good for discounts on sales, which are applied in the form of a stipulated percentage on sales value. The remaining items, advertising expense and sales clerical expense, cannot, however, be definitely connected with individual orders, and must be compiled over some previous period, in the manner described for administrative expense. They may then be charged off as a percentage on either sales value or manufacturing cost, preferably the latter.

Machine Number	Type of Machine	Productive Floor Space Occupied	Productive Floor Space Occupied by Groups of Similar Machines	Proportion of Non-Productive Floor Space	Total Floor Areas Occupied by Groups of Similar Machines	Total Floor Areas Occupied by Each Machine	Total Departmental Expense per Hr.	Machine Hourly Expense Rates
		Sq. Ft.	Sq. Ft.	(Redistrib.) Sq. Ft.	Sq. Ft.	Sq. Ft.		
D. P. M.—201	Swing mach.	267				512		$0.583
" 202	" "	267	1,068	978	2,046	512	$4.99	$0.583\left(\frac{512}{4380}\times\$4.99\right)$
" 203	" "	267				512		0.583
" 204	" "	267				512		0.583
" 301	Molette mach.	23				45		0.051
" 302	" "	23				45		$0.051\left(\frac{45}{4380}\times\$4.99\right)$
" 303	" "	23	252	235	487	45	4.99	0.051
" 304	" "	23				45		0.051
" 305	" "	80				154		0.175
" 306	" "	80				154		$0.175\left(\frac{154}{4380}\times\$4.99\right)$
" 401	Scratch Wheel	56				107		0.122
" 402	" "	56				107		0.122
" 403	" "	56				107		0.122
" 404	" "	56				107		0.122
" 405	" "	56	672	615	1,287	107	4.99	$0.122\left(\frac{107}{4380}\times\$4.99\right)$
" 406	" "	56				107		0.122
" 407	" "	56				107		0.122
" 408	" "	56				107		0.122
" 409	" "	56				107		0.122
" 410	" "	56				107		0.122
" 411	" "	56				107		0.122
" 412	" "	56				107		0.122
" 501	Cleaning Table	59				112		0.128
" 502	" "	59				112		0.128
" 503	" "	59	295	265	560	112	4.99	$0.128\left(\frac{112}{4380}\times\$4.99\right)$
" 504	Examining Table	59				112		0.128
" 505	" "	59				112		0.128
				Total Departmental Floor Space =		4,380	Total	4.99

FIG. 17. THIRD AND FINAL STAGE IN THE DEVELOPMENT OF MACHINE HOURLY RATES, SHOWING THE DETAILS OF DISTRIBUTING THE HOURLY EXPENSE IN TABLE 3 TO MACHINES BY FLOOR-SPACE RATIO

Thus when a = Floor space occupied by any machine
b = Total departmental floor space
and c = Total departmental expense factor, per hr.

then $\frac{a}{b}\times c$ = Required machine hourly rate.

Machine hourly expense rates as so developed appear in the right-hand column.

An alternative method which can usually be applied in small factories, consists of adding indirect selling expense to administrative expense, the sum of the two forming what is usually termed *general expense*. This may then be absorbed as a percentage of factory cost.

Periodical Readjustment in Expense Rates

In any plan of expense distribution, whether it be an averaging method similar to distribution by percentage on direct material, direct labor, prime cost, or by the more exact machine hourly rate, systematic corrections of existing expense rates are necessary from time to time. It has been observed that with all of these methods, total expense has been determined over a *previous* period, and has then been related to some tangible measurable element in manufacturing cost for the same period. This, obviously, is not the actual expense which is going on independently, and which the writer once heard described as evidencing itself "a little too subsequently" for immediate allocation to shop orders. The actual expense represents the overhead amounts really incurred by the orders as they pass through manufacture, and its aggregate is usually somewhat different from the predetermined amount. This may be due to some variation in the cost of indirect labor, supplies, power, etc., or to the fact that supervision has become more costly than during the previous period. Actual expense must therefore be tabulated each month by departments, and then compared with the corresponding predetermined amounts so that current expense rates may be either increased or reduced in order to absorb variations. Such a comparison is shown in Table 4, together with the amounts that actual expense varied either above or below the predetermined, in each department, during the month in question. Plus and minus signs show the direction of variation.

Application of the Averaging Method

If an averaging method of expense distribution is in use, the plus or minus variations appearing in the right-hand column must be added to, or subtracted from, the corresponding departmental predetermined amounts, and the percentage expense rate, whether it be on direct labor, direct material or prime cost, readjusted proportionately. Existing machine hourly expense rates, if these have been installed, may likewise be readily readjusted in each department, by redistributing the additional amount where the predetermined expense is low, or by subtracting where it has proved high, this adjustment being effected on the hourly basis and in proportion to the floor space occupied by individual machines.

In the foregoing discussion, the general application of the more important methods of distributing factory expense has been treated. As to the specific plan which will be most suitable for different types of small organizations, individual plants must be judged separately, and the selection governed entirely by peculiarities in the product or processes of each. There are, however, a few general principles which furnish a measure of guidance and which are worthy of mention.

If an industry is of the simple, continuous type, manufacturing a single line or a few repetitive lines of product with machines that do not vary greatly in size or character, distribution of indirect expense as a percentage on direct labor, direct material, or prime cost will usually serve. In selecting one of these three bases, each should be carefully examined and the feature that is most constant—varying in closest relation to variations in total cost—should be the one chosen. In a general way all of these methods are perfunctory and their application may be regarded as logical only where there is uniformity in the product, and where machines and processes incur expense with at least some degree of uniformity from month to month.

TABLE 4. SHOWS COMPARISON OF ACTUAL EXPENSE BY DEPARTMENTS WITH CORRESPONDING PREDETERMINED AMOUNTS JUNE—1923

DEPARTMENT	PREDETERMINED EXPENSE	ACTUAL EXPENSE	VARIATION OF PREDETERMINED ABOVE OR BELOW ACTUAL
DG	$3,463.21	$3,037.84	$+ 425.37
DC		1,050.44	−1,050.44
DP	2,392.41	3,209.04	− 816.63
DM	830.07	1,116.51	− 286.44
DS	2,085.25	1,959.83	+ 125.42
DB	857.39	885.58	− 28.19
DR	40.09	54.85	− 14.76
Admin	3,200.00	3,800.00	− 600.
TOTAL	$12,868.42	$15,114.09	$−2,245.67

In small industries of the intermittent type where many different lines of product pass through dissimilar productive operations, or incur widely varying amounts of expenses as they pass through similar ones, these averaging methods fail in their purpose. Many industries in the quality field fall into this intermittent process classification, typical examples being found in the manufacture of jewelry, high-grade furniture, and precision instruments. In these and similar lines, wide diversities in the design or finish of different articles, necessitate the use of much special equipment, each line of product perhaps passing through certain operations which are peculiar to it alone. The wisest course when the problem is of this character is to compromise as far in the direction of machine hourly rates as conditions seem to warrant. It will sometimes be found that certain features of expense are incurred by all operations with approximate uniformity while others show considerable variation. Under these conditions the uniform expense may be compiled and charged off by an averaging method, and the variable features then assembled and distributed through machine hourly rates.

Importance of a Definite Method of Distribution

It would be difficult to lay too much stress on the importance to a small manufacturing organization of *some* method of overhead distribution. The predetermination and allocation of this expense is fundamental to, and must precede the functioning of any form of cost system. It may be emphasized as a concluding axiom, that the method of distribution providing the most favorable compromise between simplicity and approximate accuracy is the one to select.

(To be concluded in the July issue.)

New Forms of Depreciation Schedules

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PROVISION for depreciation is usually made by setting up a Reserve for Depreciation account, crediting it annually with sums such that at the close of the estimated life of the asset the total which has been credited to the Reserve account shall equal the original cost, less the estimated scrap value, if any.

The purpose of this article is to outline a method which the writer believes to be new, and to have advantages in many cases.

Current methods will first be outlined for comparison, omitting those involving interest on the investment and those which are based on output—the latter partaking more of a depletion aspect than do regular depreciation methods.

For illustration, the following example will be used:

A machine cost $3,175 on January 1, 1920. It is estimated to have a life of five years and a scrap value of $57. A schedule is to be set up showing the book values of the machine on January 1, 1921, January 1, 1922, January 1, 1923, and January 1, 1924; the book value on January 1, 1925, being the scrap value.

1. Straight Line Method

This method is applied as follows:

(*a*) Deduct the scrap value from the cost.
(*b*) Divide this result by the number of years.
(*c*) Subtract this quotient from the book value at the beginning of each year to obtain the values at the close of the year.

Using the examples cited, the value of (*b*) is:

$$\frac{\$3,175-\$57}{5}=\$623.60$$

The required schedule is therefore as follows:

Book value January 1, 1920 (Cost)	$3,175.00
Deduct	623.60
Book value January 1, 1921	$2,551.40
Deduct	623.60
Book value January 1, 1922	$1,927.80
Deduct	623.60
Book value January 1, 1923	$1,304.20
Deduct	623.60
Book value January 1, 1924	$680.60
Deduct	623.60
Book value January 1, 1925 (Scrap)	$57.00

Under the straight-line method the book value decreases uniformly year by year as shown, the annual deduction in the present instance being $623.60—the value of (*b*).

Index Number
657.421 Depreciation

2. Sinking Fund Method

The process used in this method is as given below:

(*a*) Add each year to the reserve, a fixed sum found as outlined in (*c*).
(*b*) Add each year to the reserve, a fixed percentage of the total which is credited to the reserve at beginning of the year.
(*c*) The fixed percentage having been first chosen, the value of (*a*) is determined from the fact that the total which has been credited to the reserve at the close of the life of the asset shall equal the original cost, less the assumed scrap value.

Finding the value of (*a*) is the same as finding a sinking fund contribution which, accumulated at a rate of interest equal to the fixed percentage, will equal difference between original cost and scrap value.

Let: z = required sinking fund contribution (*a*).
i = fixed percentage (*b*).
$r = 1 + i$.
n = number of years.
C = cost.
S = assumed scrap value.

Then the totals which will have been credited to the reserve at the close of the successive years are:

At the close of the first year. . . . . z
At the close of the second year. . . . . $zr+z$
At the close of the third year. . . . . zr^2+zr+z
. . . . . .
At the end of the nth year. . . . . $zr^{n-1}+zr^{n-2}+\ldots+zr^2+zr+z$

Since the reserve at the close of the nth year equals the original cost, less the assumed scrap value:

$$zr^{n-1}+zr^{n-2}+\ldots+zr^2+zr+z=C-S$$

$$z\times\frac{r^n-1}{r-1}=C-S$$

Using the numerical values in the example with 4 as a fixed percentage (b):

$$z\times\frac{1.04^5-1}{1.04-1}=\$3,175-\$57$$

$$z=\frac{\$3,118\times0.04}{1.21665-1}=\$575.67$$

Accumulating the Reserve. The reserve is accumulated as follows:

Credited January 1, 1921		$575.67
Credited January 1, 1922	$575.67	
Add 4 per cent of $575.67	23.03	
Depreciation charge, January 1, 1922		$598.70
Amount of depreciation reserve, January 1, 1922		$1,174.37
Credited January 1, 1923	$575.67	
Add 4 per cent of $1,174.37	46.97	
Depreciation charge, January 1, 1923		$622.64
Amount of depreciation reserve, January 1, 1923		$1,797.01
Credited January 1, 1924	$575.67	
Add 4 per cent of $1,797.01	71.88	
Depreciation charge, January 1, 1924		$647.55
Amount of depreciation reserve, January 1, 1924		$2,444.56
Credited January 1, 1925	$575.67	
Add 4 per cent of $2,444.56	97.78	
Depreciation charge, January 1, 1925		$673.45
Amount of depreciation reserve, January 1, 1925		$3,118.01

Deducting from $3,175 the various amounts credited to the reserve so as to obtain the corresponding book values at the close of each year, we have the following:

	Book Value	*Charge to Depreciation*
January 1, 1920 (Cost)	$3,175.00	.....
January 1, 1921	2,599.33	$575.67
January 1, 1922	2,000.63	598.70
January 1, 1923	1,377.99	622.64
January 1, 1924	730.44	647.55
January 1, 1925	56.99	673.45

Shifting the Weight of Depreciation. From a mathematical standpoint, the Straight Line Method is a special case of the Sinking Fund Method when $i = 0$. For in this case every power of r is equal to 1, and the left-hand side of the equation becomes nz. The smaller the value assigned to i, the more nearly uniform the charges to depreciation become.

But suppose it is desired to shift the charge for depreciation still more to the later years than the figures shown in the schedule based on $i = 0.04$. All that is required is to assign a larger value to i. The fact that this is called a Sinking Fund Method does not require that the rate used shall be such as would be yielded by an actual sinking fund. Charges to depreciation are separate from fund for replacement of the asset.

For instance, putting $i = 0.10$ gives the following equation for finding z:

$$z \times \frac{1.10^5 - 1}{1.10 - 1} = 3,175 - 857$$

$$z = \frac{3,118 \times 0.10}{1.61051 - 1} = 510.72$$

The reserve is accumulated as follows:

Credited January 1, 1921		$510.72
Credited January 1, 1922	$510.72	
Add 10 per cent of $510.72	51.07	
Depreciation charge, January 1, 1922		$561.79
Amount of depreciation reserve, January 1, 1922		$1,072.51
Credited January 1, 1923	$510.72	
Add 10 per cent of $1,072.51	107.25	
Depreciation charge, January 1, 1923		$617.97
Amount of depreciation reserve, January 1, 1923		$1,690.48
Credited January 1, 1924	$510.72	
Add 10 per cent of $1,690.48	169.05	
Depreciation charge, January 1, 1924		$679.77
Amount of depreciation reserve, January 1, 1924		$2,370.25
Credited January 1, 1925	$510.72	
Add 10 per cent of $2,370.25	237.03	
Depreciation charge, January 1, 1925		$747.75
Amount of depreciation reserve, January 1, 1925		$3,118.00

Deducting the amount in reserve from $3,175 to obtain the corresponding book value, we have the following schedule:

	Book Value	*Charge to Depreciation*
January 1, 1920 (Cost)	$3,175.00	.....
January 1, 1921	2,664.28	$510.72
January 1, 1922	2,102.49	561.79
January 1, 1923	1,484.52	617.97
January 1, 1924	804.75	679.77
January 1, 1925 (Scrap value)	57.00	747.75

Taking a rather extreme case, assign to i a value of 50 per cent. The value of z in this case is $236.44, and the schedule of book values and depreciation charges will be found to be as follows:

	Book Value	*Charge to Depreciation*
January 1, 1920 (Cost)	$3,175.00	.....
January 1, 1921	2,938.56	$236.44
January 1, 1922	2,583.90	354.66
January 1, 1923	2,051.91	531.99
January 1, 1924	1,253.93	797.98
January 1, 1925	56.96	1,196.97

Here the charge to depreciation the last year is nearly five times that for the first year. If this difference is considered excessive, then all one need do is to choose a smaller value for i. The interesting point in the whole series of computations lies in the fact that if one does not care to use the Straight Line Method, he can adopt a method which will shift the depreciation from the earlier years to the later ones to as little, or as great, an extent as he pleases. The book values corresponding to $i = 0$ (Straight Line Method), $i = 0.04$, $i = 0.10$, $i = 0.50$ are shown in Fig. 1. But whether the difference between the depreciation charges for the first and the last years be great, or small, the charges *increase* from year to year.

3. Reducing Balance Method

Now what if it is desired to shift the charges to the earlier years, and have them *decrease* year by year? To accomplish this there are two methods in current use which will next be described. This is based on the assumption that the book value at the beginning of any year bears a constant ratio to the book value at the close of that year.

Denoting this constant ratio by k:

The initial book value (Cost) is..... C
The book value at the close of the first year is..... Ck
The book value at the close of the second year is..... Ck^2
The book value at the close of the third year is..... Ck^3
. . . . . .
The book value at the close of the nth year, which must equal the assumed scrap value, is..... Ck^n

The value of k is therefore given by the equation $Ck^n = S$, which can be solved by using logarithms.

Reverting to the illustrative example:

$$3175\,k^5 = 57$$
$$k^5 = \frac{57}{3175}$$
$$\log k = (\log 57 - \log 3175)/5$$
$$= (1.7558749 - 3.5017437)/5$$
$$= (48.2541312 - 50)/5$$
$$= 9.6508262 - 10$$

From this the numerical value of k may be found; but it is not required. Simply begin with the logarithm of the known book value January 1, 1920, that is, of the original cost, and add the logarithm of k as found above to obtain the logarithms of the successive book values, as follows:

Log. (book value, January 1, 1920) that is, log. 3175	3.5017437
Add log. k	9.6508262—10
Log. (book value, January 1, 1921)	3.1525699
Add log. k	9.6508262—10
Log. (book value, January 1, 1922)	2.8033961
Add log. k	9.6508262—10
Log. (book value, January 1, 1923)	2.4542223
Add log. k	9.6508262—10
Log. (book value, January 1, 1924)	2.1050485
Add log. k	9.6508262—10
Log. (book value, January 1, 1925)	1.7558747

The logarithm of the book value January 1, 1925, is, as it should be, the logarithm of the scrap value, thus affording a check on the work.

The book values at the various dates as obtained from their logarithms, together with the corresponding depreciation charges, are as follows:

	Book Value	*Charge to Depreciation*
January 1, 1920	$3,175.00	.....
January 1, 1921	1,420.92	$1754.08
January 1, 1922	635.92	785.00
January 1, 1923	284.59	351.33
January 1, 1924	127.36	157.23
January 1, 1925	57.00	70.36

In this case, the book values *decrease* with great rapidity at the first, especially where there is a small scrap value. If the asset is assumed to have no scrap value, then a small value must be arbitrarily used; $1 for example. Otherwise this method cannot be employed at all.

This method is supposed to meet the requirements of those who wish to set up high depreciation charges during the first few years. The trouble is that it makes these charges entirely too high at the beginning; and it is not possible to modify the method. However, a means of doing this will be offered later in this article.

4. The Weighted Year Method

In this method, it is assumed that if q denotes the depreciation during the last year of the estimated life of the asset, then the depreciation charges during the first, second, third . . . $(n-2)$, $(n-1)$, nth year are nq, $(n-1)q$, $(n-2)q$ . . . $3q$, $2q$, q.

Since the total of these charges must equal the original cost less the scrap value, $nq+(n-1)q+(n-2)q+\ldots+3q+2q+q=C-S$.

$$q\times\frac{n(n-1)}{2}=C-S.$$

Applying this to the concrete example,

$$5q+4q+3q+2q+q=\$3,175-\$57$$
$$15q=\$3,118$$
$$q=\$207.87$$

The book values and depreciation charges are as follows:

	Book Value	*Charge to Depreciation*
January 1, 1920 (Cost)	$3,175.00	.....
January 1, 1921	2,135.65	$1,039.35
January 1, 1922	1,304.17	831.48
January 1, 1923	680.56	623.61
January 1, 1924	264.82	415.74
January 1, 1925	56.95	207.87

A diagram of the book values based on the Reducing Balance and the Weighted Year Methods, together with those based on the Straight Line Method, is shown in Fig. 2. The trouble with these methods is that in one case the charge to depreciation the first year is *five times* that for the last year and in the other it is about *twenty-five* times as great. If this disparity is prohibitive, then, since these methods are both inflexible, what orderly course remains for one who wishes a decreasing series of charges to depreciation?

The Adapted Sinking Fund Method

The purpose of this article is to outline a flexible, orderly, logical process by which charges to depreciation may be made as nearly uniform as one may desire, or be made to increase from year to year as rapidly as one could wish. The Sinking Fund Method can be made to serve this purpose simply by using a *negative* value for the hypothetical interest rate. The curves showing the book values for different values of i then

lie all below the diagonal, differing from it little or by a great deal.

For instance, putting $i=-0.10$ in the formula, $z\times\frac{r_n-1}{r-1}=C-S$, we have the following:

$$z\times\frac{0.90^5-1}{0.90-1}=\$3,175-\$57$$

$$z=\$3,118\times\frac{0.90-1}{0.59049-1}$$

$$=\$3,118\times\frac{0.10}{0.40951}$$

$$=\$761.40$$

Subtracting from $3,175 the amount standing to the credit of the Reserve account at the close of each year, to obtain the corresponding book values, the schedule of book values and charges to depreciation are:

	Book Value	*Charge to Depreciation*
January 1, 1920 (Cost)	$3,175.00	.....
January 1, 1921	2,413.60	$761.40
January 1, 1922	1,728.34	685.26
January 1, 1923	1,111.61	616.73
January 1, 1924	556.55	555.06
January 1, 1925	57.00	499.55

The diagram of these book values is shown in Fig. 3.

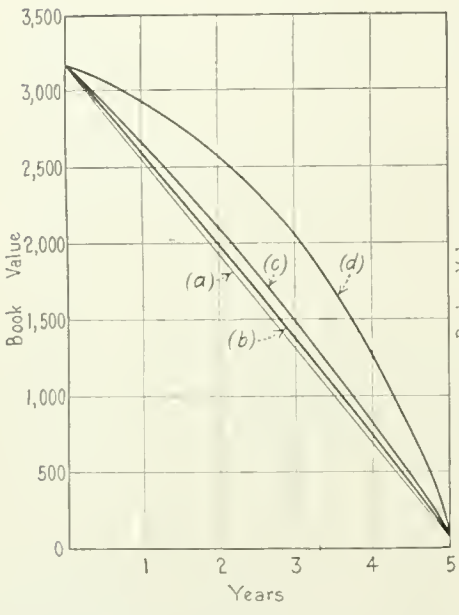

FIG. 1 SINKING FUND METHOD SHOWING BOOK VALUES WHEN (A) $i=0.0$; (B) $i=0.04$; (C) $i=0.10$; (D) $i=0.50$

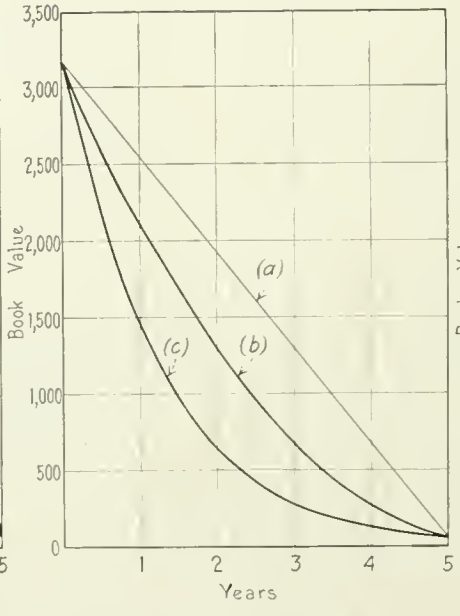

FIG. 2 BOOK VALUES BASED ON (A) REDUCING BALANCE, (B) WEIGHTED YEARS, AND (C) STRAIGHT LINE METHODS

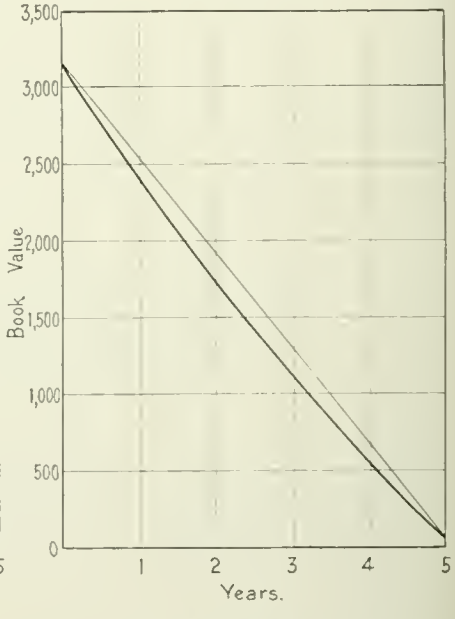

FIG. 3 BOOK VALUES BASED ON ADAPTED SINKING FUND METHOD

Credited January 1, 1921		$761.40
Credited January 1, 1921	$761.40	
Less 10 per cent of $761.40	76.14	
Depreciation charge, January 1, 1922		$685.26
Amount of depreciation reserve, January 1, 1922		$1,446.66
Credited January 1, 1922	$761.40	
Less 10 per cent of $1,446.66	144.67	
Depreciation charge, January 1, 1923		$616.73
Amount of depreciation reserve, January 1, 1923		$2,063.39
Credited January 1, 1923	$761.40	
Less 10 per cent of $2,063.39	206.34	
Depreciation charge, January 1, 1924		$555.06
Amount of depreciation reserve, January 1, 1924		$2,618.45
Credited January 1, 1924	$761.40	
Less 10 per cent of $2,618.45	261.85	
Depreciation charge, January 1, 1925		$499.55
Amount of depreciation reserve, January 1, 1925		$3,118.00

Assigning to i a value between zero and -0.10 gives a curve closer to the diagonal. Putting $i=-0.20$ gives a more convex curve.

Conclusion

In conclusion, if one does not wish to use the Straight Line Method, then a consistent method is desirable giving a series of charges to depreciation, which either increase from year to year, or decrease year by year; and such that the difference between the charges for the first and the last year shall be as great or as little as one pleases.

The formula used in the Sinking Fund Method meets all these requirements. By making the hypothetical interest rate positive, the charges to depreciation increase year by year. By assigning to it a negative value, the charges decrease. By taking values close to zero, the difference between the charges for the first and the last years is small. By taking values farther from zero, the burden can be shifted from one extreme to another. Since the Straight Line Method corresponds to $i=0$, it would seem that *the Sinking Fund Method can be made to meet every requirement.*

Materials Handling Methods That Have Added to Industrial Profits

Experience Data on Actual Installations[1]

By GEORGE E. HAGEMANN

Associate Editor, MANAGEMENT AND ADMINISTRATION

Index Number
658.281 Mechanical handling
658.281(002) Cost of conveyor systems

THE savings realized and added to profits as a result of using materials handling equipment to replace hand labor have been made a matter of record in many plants. Two cases cited here add to the evidence already presented demonstrating the economies of mechanical apparatus.

A 15-ton Brownhoist crane at the Gillespie-Eden Corporation has been operating since 1911. It handles coal from cars to storage and thence to boiler house for 36.36 per cent of the time, and takes care of 10,400 tons annually. Pig iron is moved from the railway cars to electric crane runways by the crane. About 180 tons per week are thus unloaded and the operation consumes another 36.36 per cent of the crane's time. For the rest of the time the crane handles scrap and does miscellaneous odd jobs about the plant.

FIG. 1 FIFTEEN-TON LOCOMOTIVE CRANE HANDLING PIG IRON

In the course of manufacturing, a large quantity of curlings, shearings and chips are produced. These are loaded into cars by the crane operating a bucket equipped with teeth. About two cars a week, or 70 tons, are thus handled.

The miscellaneous work performed includes unloading steel plates and lock bars from cars to storage, unloading foundry coke and limestone, and shifting cars. Formerly these jobs were done either by hand or by means of hand-operated devices.

Briefly, the cost of handling has been cut as follows: Coal 21 per cent; pig iron 46 per cent; scrap 46 per cent. The crane has saved its original cost in less than 2½ years of operation on this work.

TABLE 1. COST OF OPERATION—15-TON BROWNHOIST CRANE

Depreciation—$\frac{\$7,500.00}{20 \text{ years}}$		$375.00
Average interest at 7 per cent = $\frac{21}{20} \times \frac{\$7,500 \times 0.07}{2}$		275.62
Repairs and maintenance		500.00
Coal, ¼ ton per day × 300 days = 75 tons at $5 per ton		375.00
Labor, 1 operator, $40 per wk. × 52 wks. = $2,080		
1 helper, $25 per wk. × 52 wks. = 1,300		
Total labor		3,380.00
Total annual operating cost		$4,905.62
Tons—handled (see details below)		23,400
Average cost per ton—$\frac{\$4905.62}{23,400 \text{ tons}}$		$0.2096
Annual cost, hand method (see following data)		$8,088.00
Average cost per ton, hand method—$\frac{\$8,088.00}{23,400 \text{ tons}}$		$0.3456
Total annual saving—$8,088.00—$4,905.62		$3,182.39
Average saving per ton—$0.3456—$0.2096		$0.1360
COST OF HANDLING COAL		
Annual cost chargeable to coal—$4,905.62 × 36.36 per cent		$1,783.68
Tons handled = 200 tons per wk. × 52 wks.		10,400
Cost per ton—$\frac{\$1,783.68}{10,400 \text{ tons}}$		$0.1715
Hand labor required, 4 men × 2 days per wk. × 52 wks. × $4.00 =	$1,664.00	
Cost of operating 2 small conveyors	600.00	
Total cost of conveyor method		$2,264.00
Cost per ton, conveyor method—$\frac{\$2,264.00}{10,400 \text{ tons}}$		0.2177
Annual saving on coal—$2,264.00—$1,783.68		$480.32
Saving per ton of coal—$0.2177—$0.1715		$0.0462
COST OF HANDLING PIG IRON		
Annual cost chargeable to pig iron = $1,905.62 × 36.36 per cent =		$1,783.68
Tons handled = 4 cars per wk. × 52 wks. × 45 tons		9,360
Cost per ton = $\frac{\$1,783.68}{9,360 \text{ tons}}$		$0.1906
Hand labor required = 4 men, 1 day per car at $1 per day = $16 per car × 208 cars		3,328.00
Cost per ton, hand method = $\frac{\$3,328.00}{9,360 \text{ tons}}$		$0.3556
Annual saving on pig iron = $3,328.00—$1,783.68		$1,544.32
Saving per ton of pig iron = $.3556—$.1906		$0.1650
COST OF HANDLING SCRAP		
Annual cost chargeable to scrap = $4,905.62 × 27.28 per cent		$1,338.25
Tons handled = 2 cars per wk. × 52 wks. × 35 tons		3,640
Cost per ton = $\frac{\$1,338.25}{3,640 \text{ tons}}$		$0.3677
Hand labor required = 4 men, 1½ days per car at $4 per day = $24 per car × 101 cars		$2,496.00
Cost per ton, hand method = $\frac{\$2,496.00}{3,640 \text{ tons}}$		$0.6857
Annual saving on scrap = $2,496.00—$1,338.25		$1,157.75
Saving per ton of scrap = $.6857—$.3677		$0.3180

SUMMARY OF COSTS AND SAVINGS

MATERIAL	COST PER YEAR		SAVING PER YEAR	COST PER TON		SAVING PER TON
	HAND	CRANE		HAND	CRANE	
Coal	$2,264.00	$1,783.68	$480.32	$.2177	$.1715	$.0462
Pig Iron	$3,328.00	$1,783.68	$1,544.32	$.3556	$.1906	$.1650
Scrap	$2,496.00	$1,338.25	$1,157.75	$.6857	$.3677	$.3180
Totals and Averages	$8,088.00	$4,905.61	$3,182.39	$.3456	$.2096	$.1360

[1] See MANAGEMENT AND ADMINISTRATION, May 1924, p. 557, for additional data.

TABLE 2. COST OF OPERATING LINK-BELT CONVEYOR, QUARTER CAPACITY

ITEM	METHOD OF CALCULATION	TOTAL	COAL	ASH
Depreciation	$20,275 ÷ 30 yr	675.83	450.55	225.28
Average interest at 6 per cent	$\frac{31 \times 20,275 \times 0.06}{30 \times 2}$	628.53	419.02	209.51
Repairs and maintenance	Estimated	100.00	66.67	33.33
Oil	28 gal. at 18 cents a gal	5.04	3.36	1.68
Insurance	0.002×20,275	40.55	27.03	13.52
Power—coal	$\frac{6408}{19}$ = 337 hr.×21 kw. = 7077 kw. hr.×1½ cents	.....	79.62	.....
Power—ash	$\frac{1500}{19}$ = 79 hr.×2 handlings = 158 hr.×21 kw. = 3318 kw. hr.×1½ cents	.....	.....	37.33
Power—coal and ash	79.62+37.33	116.95	.....	.....
Labor—coal	1 man at 70 cents and 1 man at 52 cents = $1.22 per hr.[1] $1.22 per hr.×337 hr. =	.....	411.14	.....
Labor—ash	1 man at 70 cents×79 hr ..... 55.30 1 man at 70 cents $1.74 per hr.×79 hr.[2] ..... 137.46 2 men at 52 cents 192.76	.....	.....	192.76
Labor—coal and ash	411.14+192.76	603.90	.....	.....
Totals		2,170.80	1,457.39	713.41
Cost per ton of coal.	$\frac{1457.39}{6408}$	.....	0.2274	.....
Cost per ton of ash (two handlings)	$\frac{713.41}{1500}$	.....	.....	0.4756
Cost per ton of ash, per handling	$\frac{713.41}{3000}$	.....	.....	0.2378

[1]Man at conveyor $0.70 per hr. Man in car $0.52 per hr.
[2]Man at conveyor $0.70 per hr. Man in car and man at dump $0.52 per hr. each.

TABLE 3. COST OF OPERATING LINK-BELT CONVEYOR, FULL CAPACITY

ITEM	METHOD OF CALCULATION	TOTAL	COAL	ASH
Depreciation	$20,275 ÷ 20 yr	1,013.75	675.83	337.92
Average interest at 6 per cent	$\frac{21 \times 20,275 \times 0.06}{20 \times 2}$	638.66	425.77	212.89
Repairs and maintenance	Estimated	200.00	133.33	66.67
Oil	Estimated 56 gals. at 18 cents a gal	10.08	6.72	3.36
Insurance	0.002×20,275	40.55	27.03	13.52
Power—coal	4×79.62	.....	318.48	.....
Power—ash	4×37.33	.....	.....	149.32
Power—coal and ash	318.48+149.32	467.80	.....	.....
Labor—coal	4×411.14	.....	1,644.56	.....
Labor—ash	4×192.76	.....	.....	771.04
Labor—coal and ash	1644.56+771.04	2,415.60	.....	.....
Totals		4,786.44	3,231.72	1,554.72
Cost per ton of coal	$\frac{3231.72}{25,632}$	.....	0.1261	.....
Cost per ton of ash (two handlings)	$\frac{1554.72}{6000}$	.....	.....	0.2591
Cost per ton of ash per handling	$\frac{1554.72}{12,000}$	.....	.....	0.1296

Economy data for this crane are given in Table 1. Fig. 1 shows a crane of the 15-ton type handling pig iron with a magnet.

The heating and lighting station of the Wisconsin State Capitol Building employs Link-Belt equipment in handling coal and ashes. The installation consists of a hopper beneath the tracks, a reciprocating feeder, a crusher, and three Peck carriers. This equipment handles 6408 tons of coal and approximately 1500 tons of ashes each year.

From the car on the siding the coal drops into a hopper below ground and is taken by the reciprocating feeder to the crusher. A Peck cross carrier receives it from the crusher and discharges it into two longitudinal carriers which carry it up into bins. From there it goes to mechanical stokers.

In handling ashes the process is reversed. The lower runs of the longitudinal conveyors pass under the ash-pits. Ashes are fed directly into the buckets and delivered into one of two overhead concrete storage bins. When a car has been set the ashes are fed by gravity to the longitudinal conveyors, which deliver them to the cross-conveyor leading to a chute that discharges into the car.

In figuring the cost of operating the system, it is necessary to separate the items chargeable to coal handling from those chargeable to ash handling. Depreciation, interest, repairs and maintenance, oil and insurance, are apportioned according to the tons of coal and ashes handled. The actual tonnage of ash has been doubled because this material is handled twice. This means practically 3000 tons of ash to the 6000 tons of coal actually handled each year, or a total tonnage of 9000 tons. Consequently two-thirds of the total expenses have been charged to the handling of coal, and the remaining one-third to ash. See Table 2.

The Link-Belt installation is designed to handle a far greater capacity than present requirements necessitate. Of the four boilers installed, not more than two are ever used at any one time, and the plant has been designed to accommodate eight in all. The present operation, therefore, is using only one-quarter of the available capacity.

Using the figures established under present requirements, it can be definitely figured what the ton costs will be when the plant is running at full capacity. Table 3 shows the various items of expense as they would be in this case with factors adjusted to the demands of increased service.

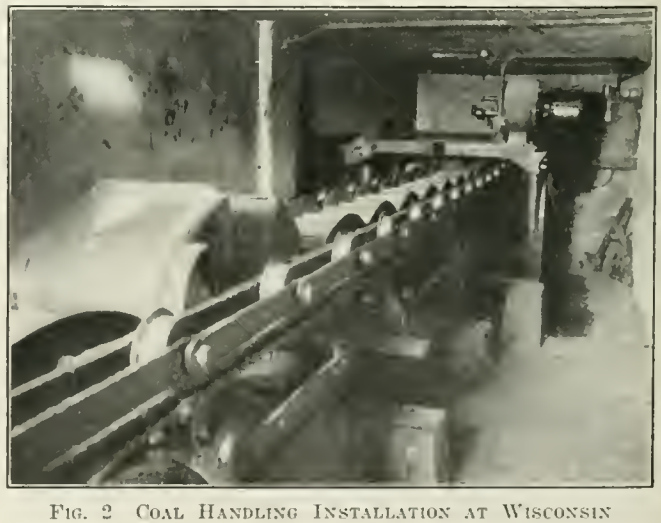

FIG. 2 COAL HANDLING INSTALLATION AT WISCONSIN STATE CAPITOL

Standard Forms for Office and Shop Use

Management Data Summary—Number 27*

SELECTION of paper is the first requirement in making up shop and office forms. The advice of the printer is useful, but for best results it is necessary that the customer have a knowledge of certain fundamentals.

Use requirements determine the proper kind of paper to choose. Such requirements are based on four main factors:†

1. Longevity—The length of time which the paper must resist deterioration.
2. Treatment—The amount and severity of handling, folding, or exposure to which the paper will be subjected.
3. Impress—The hand or mechanical method of applying the reading matter, illustrations, decorations, or rulings.
4. Appearance—The character or sense appeal in the paper itself.

Longevity depends on the kind of materials in the paper. Mechanically made wood-pulp produces the newspaper grade. Chemical wood-pulp is produced by treatment to remove the lignus material and retain the cellulose. The further this process is carried, the better the paper. Cotton and linen rags are 100 per cent cellulose and produce the most lasting paper.

Treatment that the paper must stand determines the tensile and folding strength, stiffness, and body or weight that it must have. Loft-drying produces a more uniform and stronger sheet than machine-drying.

Impress involves several considerations. In offset printing shrinkage is a factor; in mimeograph work, absorbency; in pen and pencil work, non-absorbing and erasive qualities. Finish, weight, color, opacity, and stiffness are also involved.

Appearance is influenced by personal opinion and depends on materials, but principally on the finish. The latter is produced by one of four general methods: Machine finishing; super-calendering; sheet calendering; and sheet-plating, which consists in transferring a surface impression from a fabric to the paper.

The longevity requirement depends on how long the paper is to be kept. Paper may be selected on the basis of its permanency as follows:

Time to be Kept	Life and Make-up of Paper
1 to 3 years	Temporary—No rag necessary
5 to 15 years	Semi-permanent—25 to 60 per cent rag content
20 years or over	Permanent—75 to 100 per cent rag necessary

Deeds, life insurance policies, and stock certificates are of the class requiring permanency; legal documents, controlled by statutory limits, are of the semi-permanent class, while daily records are in the temporary class.

Index Number
676(003) Paper standardization
651.71 Office forms

Treatment to which paper will be subjected involves the consideration of:

1. Amount and frequency of handling—number of times daily, weekly, etc.
2. Period of handling—days, weeks, months, or years.
3. Character of handling—normal, rough, abusive.
4. Amount and character of folding.
5. Exposure to unusual conditions of dirt, grit, moisture, industrial fumes, etc.
6. Amount of protection against abrasion and misuse, with reference to method in which kept or carried.

Table 1 shows the kinds of paper suitable for various purposes in forms and stationery:

TABLE 1. CLASSIFICATION OF PAPERS ACCORDING TO USE

Service	Kind of Paper	Remarks
Bookkeeping machines	Bond, generally. Ledger for permanence.	
Hectographing	Bond, ledger, writing, or bristol.	25 to 150 copies obtainable.
Letter-press printing (type and rule	Bond, ledger, writing, or index bristol.	
Lithographing	Same as for letter-press printing.	Shrinkage is a factor in two-color work.
Machine ruling	Bond, ledger, writing, or bristol.	High-grade unglazed bonds may cockle.
Mimeographing	Unsized, absorbent.	Use bond or ledger if signed in ink.
Multigraphing	Bond, ledger, writing, or index bristol.	
Pen writing	Ledger and flat writing.	
Pencil writing	Bond or bristol.	
Typewriting	Bond or bristol.	High-grade for erasure.

Appearance can be classified only as:

1. Representative—From whom sent, to whom sent, or of message contained.
2. Distinctive—With reference to distinguishing color or make-up.
3. Novel—A non-standard condition, in most cases to be avoided.

In office and factory forms—excepting letterheads, invoices, etc., which are sent to customers or prospective customers—a paper selected on the basis of longevity, treatment, and impress will have sufficient appearance for the purpose.

For multiple copies of forms colors have often been used. There is a growing tendency, however, to abandon colors and distinguish copies by large outlined numerals.

* This article is one of a series which gives in concise, factual form standardized methods and accepted practice generally applicable in industrial operations.

† See *Management Engineering*, January 1923, p. 61, "Selecting Paper for Shop and Office Forms," by C. L. Barnum.

Colors for multiple copies of forms are usually:

Original	White
Duplicate	Buck, primrose, or canary
Triplicate	Pink
Quadruplicate	Blue

When the kind of paper has been selected according to the above considerations, the size for each specific purpose must be determined. Sizes are based upon dimensions of original sheets, and involve two requirements, for best results:

1. For economy, they should cut without waste from original sheets.
2. For simplicity, the number of sizes used for all purposes should be limited to a reasonable minimum, avoiding abnormal dimensions.

A Committee on Simplification of Paper Sizes was appointed by the Bureau of Standards, Department of Commerce, from all groups of paper makers and users, on August 30, 1921. This committee has recently presented a report whose findings have just been published [2] as standard recommendations to be tried out by manufacturers and consumers of paper for a year, starting July 1, 1924.

The sizes of original sheets adopted in this report as desirable standards are listed below. Book and magazine papers, although beyond the scope of this data sheet, are included as a matter of information because of their use in advertising matter, house organs, etc.; and, likewise, roll sizes are noted in each instance.

1. Book papers, including advertising matter (and catalogs).

SHEET SIZES—IN.	DOUBLE SIZES—IN.
26 x 29	29 x 52
25 x 38	38 x 50
32 x 44	44 x 64
35 x 45½	45½ x 70

Roll sizes 25, 26, 28, 29, 30½, 32, 33, 35, 38, 41, 42, 44, 45½, 46, 50, 52, 56, 61, 64 in.

2. General office and factory forms and letterhead printing:

SHEET SIZES—IN.	DOUBLE SIZES—IN.
17 x 22	22 x 34
17 x 28	28 x 34
19 x 24	24 x 38

Roll sizes 17, 19, 22, 24, 28, 32, 34, 38 in.

3. Bond, writing and ledger forms:

SHEET SIZES—IN.	DOUBLE SIZES—IN.
17 x 22	22 x 34
17 x 28	28 x 34
19 x 24	24 x 38

[2] Pamphlet on "Paper," Elimination of Waste series, published by the Department of Commerce, March 10, 1924.

Out of these sizes can be cut practically all of the business forms and letterheads, and many envelopes that are in use.

4. Ledger paper for record and blank book purposes:

SHEET SIZES—IN.	DOUBLE SIZES—IN.
16 x 21	21 x 32
18 x 23	23 x 36
17 x 28	28 x 34
19 x 24	24 x 38

5. Bank checks:

SHEET SIZES—IN.	DOUBLE SIZES—IN.
19 x 26	26 x 38
19 x 28	28 x 38

Roll widths for (3), (4), and (5), 16, 17, 18, 19, 21, 22, 23, 24, 28, 32, 34, 38 in.

6. Loose-leaf record book sheets and forms: [3]

22½ x 22½ 24½ x 24½

Table 2 shows sizes of forms that the report of the Committee on Simplification lists as cutting without waste from the standard original sheets recommended:

TABLE 2. SIZES OF FORMS FOR LETTERHEADS, OFFICE AND FACTORY FORMS THAT CUT AND PRINT FROM STANDARD SIZES OF BOND LEDGER AND WRITING PAPERS WITHOUT WASTE.

No. from Sheet	17 x 22 In.	22 x 34 In.	17 x 28 In.	28 x 34 In.	19 x 24 In.	24 x 38 In
2 out	11 x 17	17 x 22	14 x 17	17 x 28	12 x 19	19 x 24
4 out	8½ x 11	11 x 17	8½ x 14	14 x 17	9½ x 12	12 x 19
6 out	8½ x 7 5/16	7 3/16 x 17	8½ x 9 5/16	11 3/16 x 14	9½ x 8	12 x 12 5/8
6 out	5 5/8 x 11	11 x 11 3/16	5 5/8 x 14	9 3/16 x 17	6 5/16 x 12	8 x 19
8 out	4¼ x 11	8½ x 11	7 x 8½	7 x 17	4¾ x 12	9½ x 12
8 out	5½ x 8½	5½ x 17	4¼ x 14	8½ x 14	6 x 9½	6 x 19
9 out	5 5/8 x 7 5/16	7 5/16 x 11 5/16	5 5/8 x 9 5/16	9 3/16 x 11 5/16	6 5/16 x 8	8 x 12 5/8
10 out	4¾ x 8½	6¾ x 11	5½ x 8½	6¾ x 14	4¾ x 9½	7½ x 12
12 out	4¼ x 7 5/16	7 5/16 x 8½	4¼ x 9 5/16	8½ x 9 5/16	4¾ x 8	8 x 9½
12 out	5 5/8 x 5½	5½ x 11 5/16	5 5/8 x 7	7 x 11 5/16	6 5/16 x 6	6 x 12 5/8
15 out	4 3/16 x 5 5/8	4 3/16 x 11 5/16	3 3/16 x 9 5/16	5½ x 11 5/16	3¾ x 8	4¾ x 12 5/8
15 out	3 3/16 x 7 3/16	6¾ x 7 5/16	5½ x 5 5/8	6¾ x 9 5/16	4¾ x 6 5/16	7½ x 8
16 out	4¼ x 5½	5½ x 8½	4¼ x 7	7 x 8½	4¾ x 6	6 x 9½
18 out	3 5/8 x 5 5/8	5 5/8 x 7 5/16	4 5/8 x 5 5/8	5 5/8 x 9 5/16	4 x 6 5/16	6 5/16 x 8
20 out	3¾ x 5½	4 3/16 x 8½	3¾ x 7	5½ x 8½	3¾ x 6	4¾ x 9½
20 out	4¼ x 4 3/8	5½ x 5 13/16	4¼ x 5½	6¾ x 7	4¾ x 4¾	6 x 7½
24 out	3 5/16 x 4¼	3 5/16 x 8½	2 13/16 x 7	4 5/8 x 8½	4 x 4¾	6 x 6 5/16
24 out	2 13/16 x 5½	5½ x 5 5/8	4¼ x 4 5/8	5 5/8 x 7	3 1/16 x 6	4 x 9½
28 out	2 3/16 x 5½	5½ x 4 13/16	4 x 4¼	4 13/16 x 7	3 3/16 x 4¾	5 3/16 x 6
28 out	3 1/16 x 4¼	3 1/16 x 8½	2 3/16 x 7	4 x 8½	2 5/8 x 6	3 3/16 x 9½
32 out	2 1/16 x 5½	2¾ x 8½	2 1/16 x 7	3½ x 8½	2 3/16 x 6	3 x 9½
32 out	2¾ x 4¼	4¼ x 5½	3½ x 4¼	4¼ x 7	4¾ x 3	4¾ x 6

Standard roll widths: 17, 19, 22, 24, 28, 32, 34, 38, in.

Table 3 [4] is an extensive list of form sizes, by groups, that will cut without waste from the sheets indicated.

A standard invoice form, approved by the National Association of Purchasing Agents, is 8½ x 7 in., cutting four out of a 17 x 28 in. sheet. The 8½ x 14 in. size is also recommended. Checks 3⅜ x 8⅜ in. cut from the 17 x 28 in. sheet with allowance of ⅛ in. for trim. This check size is standard with the American Bankers Association and the National Association of Lithographers.

[3] Sizes 22½ x 28½ in. and 24½ x 28½ in. are at present made but are recommended to be dropped.

[4] Prepared by C. L. Barnum.

STANDARD TYPE FACES

ALTERNATE GOTHIC NO. 1
12 POINT CAPS AMERICAN TYPE FOUNDERS CO.
ABCDEFGHIJKLMNOPQRSTUVWXYZ&.,-':;!?$1234567890

NEWS GOTHIC CONDENSED
10 POINT CAPS AND LOWER CASE AMERICAN T. F. CO.
ABCDEFGHIJKLMNOPQRSTUVWXYZ&$1234567890
abcdefghijklmnopqrstuvwxyz.,-';:!?

NEWS GOTHIC EXTRA CONDENSED
12 POINT CAPS AND LOWER CASE AMERICAN T. F. CO.
ABCDEFGHIJKLMNOPQRSTUVWXYZ&$1234567890
abcdefghijklmnopqrstuvwxyz.,-';:!?

COPPERPLATE GOTHIC, HEAVY
12 POINT NO. 26
ABCDEFGHIJKLMNOPQRSTUV
WXYZ&.,-':;!?$1234567890

COPPERPLATE GOTHIC, BOLD
12 POINT NO. 46
ABCDEFGHIJKLMNOPQRSTUV
WXYZ&.,-':;!?$1234567890

COPPERPLATE GOTHIC, HEAVY CONDENSED
12 POINT NO. 16
ABCDEFGHIJKLMNOPQRSTUV
WXYZ&.,-':;!?$1234567890

FIG. 1 SAMPLE OF STANDARD TYPE—FULL SIZE

Index bristols come in sizes for use as follows:

SIZE OF SHEET—IN.	SIZES OF CARDS CUT—IN.
20½ x 24¾	3 x 5, 4 x 6, 5 x 8
22½ x 28½	3½ x 5½ card for mailing or enclosure in a No. 6¾ envelope.
25½ x 30½	3 x 5. Cuts more at a time than the 20½ x 24¾ sheet.
22 x 28½	3½ x 5½. Post card weight and finish.

New forms should be built on a standard size sheet, rather than cutting sheets to fit the form. A 50 per cent paper waste may result from haphazard laying out of printing. If 2, 4, 6, 8, 16 or more of the same form can be set up at a time, the cost may be less on a large order than single runs. In all cases a 1/16 in. trim all around gives the printer a little leeway and produces uniform results.

The following sizes, out of the many in Table 3 are recommended[5] as ample for practically every requirement of the average business organization:

3 x 5 in.	3½ x 4¼ in.
3½ x 8½ in.	4 x 6 in.
4¼ x 5½ in.	5½ x 8½ in.
7 x 8½ in.	8½ x 11 in.
	8½ x 14 in.

With regard to standards of printing little can be said, as there has been no concerted effort toward unity. This is true also of Germany and other European countries, where, however, paper sizes have reached an advanced stage under the leadership of the national standardization committees.[6] As an example of what can be accomplished in the line of type standardization the accompanying specimens are reproduced. Fig. 1 represents portions of a standards sheet[7] used to indicate correct sizes and styles of type to use in printing up business forms.

Layout of forms has not been standardized, except to a limited extent by groups of management engineers, and in large individual organizations operating several plants, where the economies of uniformity are self-evident.

[5] See *Management Engineering*, February 1923, p. 117, "Standard Sheets of Paper for Forms," by C. L. Barnum.

[6] See "Papierformate". Dinlmch 1. Normenausschuss der Deutschen Industrie (Standards Committee of German Industry).

[7] Courtesy of Williamson & Burgdolt. Bulletin No. 101.

TABLE 3. SIZES OF FORMS THAT CUT AND PRINT WITHOUT WASTE FROM STANDARD FLAT PAPERS

NOMINAL DIMENSIONS IN.	ACTUAL DIMENSIONS OF INDIVIDUAL FORMS IN.	NUMBER CUT FROM ONE SHEET	SIZES OF SHEETS FROM WHICH CUT
2 x 3	2 x 3 1/8	72	19 x 24
	2 x 3 3/4	60	19 x 24
	2 1/16 x 3	72	19 x 24
	2 1/16 x 3 3/8	63	19 x 24
	2 1/8 x 3 1/16	72	17 x 28
		56	17 x 22
	2 1/8 x 3 1/2	64	17 x 28
	2 1/8 x 3 5/8	48	17 x 22
	2 3/16 x 3 1/16	50	17 x 22
	2 3/16 x 3 1/8	45	17 x 22
	2 3/16 x 3 3/8	60	17 x 22
	2 3/16 x 3	64	19 x 24
	2 3/8 x 3 1/16	54	17 x 22
	2 3/8 x 3 1/2	56	17 x 28
	2 5/16 x 3	56	19 x 24
	2 5/16 x 3 3/8	49	19 x 24
	2 3/4 x 3 1/8	40	17 x 22
	2 3/4 x 3 1/4	50	17 x 22
	2 5/16 x 3 1/16	54	17 x 28
	2 5/16 x 3 1/2	48	17 x 22
	2 5/16 x 3 5/8	36	17 x 22
		42	17 x 22
2 x 4	2 x 4 1/16	108	24 x 38
	2 x 4 1/4	48	19 x 24
	2 1/16 x 4	54	19 x 24
	2 1/16 x 4 1/4	45	19 x 24
	2 1/8 x 4	56	17 x 22
	2 1/8 x 4 1/4	40	17 x 22
	2 1/8 x 4 3/8	48	17 x 28
	2 3/16 x 4 1/16	40	17 x 22
	2 3/16 x 4 5/16	70	22 x 34
	2 3/16 x 4 1/4	36	17 x 22
	2 3/16 x 4 1/4	48	17 x 28
	2 3/16 x 4 5/16	63	22 x 34
	2 3/16 x 4 5/16	84	28 x 34
	2 3/8 x 4	48	19 x 24
	2 3/8 x 4	40	17 x 22
	2 3/8 x 4 5/16	90	24 x 38
	2 3/8 x 4 3/8	35	17 x 22
	2 3/8 x 4 5/8	42	17 x 28
	2 3/8 x 4 3/4	40	19 x 24
	2 5/16 x 4 5/16	81	24 x 38
	2 5/16 x 4 3/4	36	19 x 24
	2 5/16 x 4	42	19 x 24
	2 5/16 x 4 1/4	35	19 x 24
	2 3/4 x 4 1/4	32	17 x 22
	2 3/4 x 4 1/4	40	17 x 28
	2 3/4 x 4 5/16	56	22 x 34

TABLE 3. SIZES OF FORMS THAT CUT AND PRINT WITHOUT WASTE FROM STANDARD FLAT PAPERS—(*Continued*)

Nominal Dimensions in.	Actual Dimensions of Individual Forms in.	Number Cut From One Sheet	Sizes of Sheets From Which Cut
3 x 3	3 1/16 x 3	48	19 x 24
	3 3/8 x 3 1/16	35	17 x 22
	3 3/8 x 3 1/16	45	17 x 28
	3 3/8 x 3 1/8	42	19 x 24
	3 3/8 x 3 1/2	40	17 x 28
	3 3/8 x 3 5/8	30	17 x 22
	3 3/4 x 3	40	19 x 24
	3 3/4 x 3 1/16	63	22 x 34
	3 3/4 x 3 1/16	81	28 x 34
	3 3/4 x 3 1/2	72	28 x 34
	3 3/4 x 3 5/8	54	22 x 34
3 x 4	3 x 4 3/16	72	24 x 38
	3 x 4 3/4	32	19 x 24
	3 1/16 x 4 1/4	28	22 x 34
	3 1/16 x 4 1/4	36	28 x 34
	3 1/16 x 4 5/16	49	22 x 34
	3 1/16 x 4 5/16	63	28 x 34
	3 1/8 x 4	36	19 x 24
	3 1/8 x 4 1/4	28	17 x 22
	3 1/8 x 4 3/4	30	19 x 24
	3 3/8 x 4 3/16	63	24 x 38
	3 3/8 x 4 3/8	25	17 x 22
	3 3/8 x 4 3/4	28	19 x 24
	3 1/2 x 4 1/4	32	17 x 28
	3 1/2 x 4 5/16	56	28 x 34
	3 5/8 x 4 1/4	24	17 x 22
	3 5/8 x 4 5/16	42	22 x 34
	3 3/4 x 4	20	19 x 24
	3 3/4 x 4	63	28 x 34
	3 3/4 x 4 3/8	45	22 x 34
	3 3/4 x 4 5/8	54	28 x 34
	3 3/4 x 4 3/4	25	19 x 24
3 x 5	3 x 5 3/8	56	24 x 38
	3 1/16 x 5 5/8	21	17 x 22
	3 1/16 x 5 5/8	27	17 x 28
	3 3/8 x 5 3/8	49	24 x 38
	3 3/8 x 5 1/2	20	17 x 22
	3 1/2 x 5 5/8	24	17 x 28
	3 5/8 x 5 5/8	18	17 x 22
	3 3/4 x 5 1/2	36	22 x 34
	3 3/4 x 5 9/16	45	28 x 34
3 x 6	3 x 6 5/16	24	19 x 24
	3 1/16 x 6 3/4	35	22 x 34
	3 1/16 x 6 3/4	45	28 x 34
	3 1/8 x 6	24	19 x 24
	3 3/8 x 6 5/16	21	19 x 24
	3 1/2 x 6 3/4	40	28 x 34
	3 5/8 x 6 3/4	30	22 x 34
	3 3/4 x 6	20	19 x 24
3 x 7	3 x 7 9/16	40	24 x 38
	3 3/8 x 7	20	17 x 28
	3 3/8 x 7 5/16	15	17 x 22
	3 3/8 x 7 9/16	35	24 x 38
	3 3/4 x 7	63	28 x 34
	3 3/4 x 7 5/16	27	22 x 34
3 x 8	3 1/16 x 8 1/2	14	17 x 22
	3 1/16 x 8 1/2	18	17 x 28
	3 1/8 x 8	18	19 x 24
	3 1/8 x 8 1/2	28	22 x 34
	3 1/2 x 8 1/2	16	17 x 28
	3 5/8 x 8 1/2	12	17 x 22
	3 3/4 x 8	15	19 x 24
	3 15/16 x 8 1/2	24	22 x 34
3 x 9	3 x 9 1/2	16	19 x 24
	3 3/8 x 9 5/16	15	17 x 28
	3 3/8 x 9 1/2	14	19 x 24
	3 3/4 x 9 5/16	27	28 x 34
4 x 4	4 x 4 3/16	54	24 x 38
	4 x 4 1/4	28	17 x 28
	4 x 4 3/4	24	19 x 24
	4 3/16 x 4 3/4	45	24 x 38
	4 1/4 x 4 3/8	20	17 x 22
	4 1/4 x 4 5/8	24	17 x 28
	4 3/8 x 4 1/4	20	17 x 22
	4 3/4 x 4 3/4	20	19 x 24
	4 15/16 x 4	49	28 x 34
	4 15/16 x 4 3/8	35	22 x 34
	4 15/16 x 4 5/8	42	28 x 34
4 x 5	4 x 5 3/8	42	21 x 38
	4 x 5 5/8	21	17 x 28
	4 1/4 x 5 1/2	16	17 x 22
	4 1/4 x 5 9/16	20	17 x 28
	4 3/8 x 5 5/8	15	17 x 22
	4 5/8 x 5 5/8	18	17 x 28
	4 3/4 x 5 3/4	20	19 x 24
	4 15/16 x 5 1/2	28	22 x 34
	4 15/16 x 5 9/16	35	28 x 34
4 x 6	4 x 6 3/16	18	18 x 24
	4 x 6 3/4	35	38 x 24
	4 1/16 x 6	36	24 x 38
	4 3/4 x 6 3/4	25	22 x 34
	4 5/8 x 6 3/4	30	28 x 34
	4 3/4 x 6	16	19 x 24
	4 3/4 x 6 1/16	15	19 x 24

TABLE 3. SIZES OF FORMS THAT CUT AND PRINT WITHOUT WASTE FROM STANDARD FLAT PAPERS—(*Continued*)

Nominal Dimensions in.	Actual Dimensions of Individual Forms in.	Number Cut From One Sheet	Sizes of Sheets From Which Cut
4 x 7	4 x 7 7/16	30	24 x 38
	4 1/4 x 7	16	17 x 28
	4 1/4 x 7 5/16	12	17 x 22
	4 15/16 x 7	28	28 x 34
	4 15/16 x 7 5/16	21	22 x 34
4 x 8	4 x 8 1/2	14	17 x 28
	4 5/16 x 8	27	24 x 38
	4 3/8 x 8 1/2	10	17 x 22
	4 5/8 x 8 1/2	12	17 x 28
	4 3/4 x 8	12	19 x 24
4 x 9	4 x 9 1/2	12	19 x 24
	4 1/4 x 9 5/16	12	17 x 28
	4 3/4 x 9 1/2	10	19 x 24
	4 15/16 x 9 5/16	21	28 x 34
4 x 11	4 x 11 5/16	21	28 x 34
	4 1/4 x 11	8	17 x 22
	4 3/8 x 11 5/16	15	22 x 34
	4 5/8 x 11 5/16	18	28 x 34
	4 15/16 x 11	14	22 x 34
4 x 12	4 x 12 5/8	18	24 x 38
	4 5/16 x 12	18	24 x 38
	4 3/4 x 12	8	19 x 24
	4 3/4 x 12 5/8	15	24 x 38
4 x 14	4 1/4 x 14	8	17 x 28
	4 15/16 x 14	14	28 x 34
5 x 5	5 9/16 x 5 5/8	15	17 x 28
	5 5/8 x 5 1/2	12	17 x 22
5 x 6	5 3/8 x 6	28	24 x 38
	5 1/2 x 6 3/4	20	22 x 34
5 x 7	5 5/8 x 7	12	17 x 28
	5 5/8 x 7 5/16	9	17 x 22
5 x 8	5 3/4 x 8	21	24 x 38
	5 1/2 x 8 1/2	8	17 x 22
	5 9/16 x 8 1/2	10	17 x 28
5 x 9	5 5/8 x 9 5/16	9	17 x 28
5 x 11	5 1/4 x 11 5/16	12	22 x 34
	5 9/16 x 11 5/16	15	28 x 34
	5 5/8 x 11	6	17 x 22
5 x 12	5 3/4 x 12	14	24 x 38
5 x 14	5 5/8 x 14	6	17 x 28
5 x 17	5 1/2 x 17	4	17 x 22
6 x 6	6 5/16 x 6	12	19 x 21
6 x 7	6 x 7 1/2	20	24 x 38
	6 3/4 x 7	20	28 x 34
	6 3/4 x 7 5/16	15	22 x 34
6 x 8	6 5/16 x 8	9	19 x 24
6 x 9	6 x 9 1/2	8	19 x 24
	6 3/4 x 9 5/16	15	28 x 34
6 x 11	6 3/4 x 11	10	22 x 34
6 x 12	6 x 12 5/8	12	24 x 38
	6 5/16 x 12	6	19 x 24
6 x 14	6 3/4 x 14	10	28 x 34
6 x 19	6 x 19	8	24 x 38
7 x 8	7 x 8 1/2	8	17 x 28
	7 7/16 x 8 1/2	6	17 x 22
	7 9/16 x 8	15	24 x 38
7 x 11	7 x 11 5/16	12	28 x 34
	7 5/16 x 11 5/16	9	22 x 34
7 x 12	7 9/16 x 12	10	24 x 38
8 x 11	8 1/2 x 11	4	17 x 22
8 x 14	8 1/2 x 14	4	17 x 28
9 x 12	9 1/2 x 12	4	19 x 24
11 x 14	11 5/16 x 14	6	28 x 34
12 x 12	12 x 12 5/8	6	24 x 38
14 x 17	14 x 17	2	17 x 28
17 x 28	17 x 28	2	28 x 34
19 x 24	19 x 24	2	24 x 38

A Comparison of Premium Wage Plans

Job Costs, Amounts of Wages and Relative Advantages Under Different Systems

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Index Number
658.3225 Premium wage plans

IN recent years there has been an increasing amount of interest shown among manufacturers and other students of industrial problems in the so-called premium-wage plans. Many concerns have found it desirable to change over from the ordinary day-work and piece-work plans to some one of the premium systems. Before taking up any of these in detail, however, let us first consider some of the fundamentals common to all premium plans. These are:

1. A certain base rate per hr.
   This base rate depends on the skill required for the job, prevailing rates in the community, and other considerations. It is not fixed but is subject to revision at any time.
2. The standard time for the job.
   This is understood to be the normal time for completing the job, after allowing for fatigue, delays, etc.
3. The incentive allowance.
   This is understood to be the operator's share in the extra efficiency created, due to the elimination of waste, etc., by the management and the men. Perhaps an example will illustrate it clearly:

   Suppose a job is now requiring, say, 2 hr. to complete. A careful time- and motion-study indicates that it can be done in, say, 0.87 hr. This is the ideal or minimum time for doing the job and cannot be realized over any considerable period. Provision must be made for fatigue, personal necessities, unavoidable delays, etc. This extra provision varies, of course, with conditions, but in general may be assumed at about 15 per cent of the minimum time. Addition of this percentage to 0.87 gives 1 hr., which becomes the standard time for doing the job. It will be noted that the standard time in this example (which is typical of a good many day-work shops) is just one-half of the actual time. Now in order that standard conditions be attained, it may be necessary that the management on the one hand install new devices, standardize equipment, revise feeds and speeds, improve working conditions, etc.; on the other hand, the operator may have to eliminate waste motions, and work faster.

   Ordinarily, when the operator is asked to expend more energy and work harder, it is necessary to give him an incentive or an extra wage allowance. This is the incentive allowance and represents the operator's share in the extra production created through his co-operation and that of the management. No hard and fast rule can be laid down for this allowance, as it varies with conditions. In the present example, it may happen that the increased production is due, roughly, two-thirds to the management and one-third to the operators. The incentive allowance would then be set at one-third or 33 1/3 per cent.

   In comparing premium plans, it must be remembered that the incentive allowance would, of course, be the same for all plans. Furthermore, wages for a definite period would be the same *at standard conditions* under all plans; direct labor costs of the job would also be identical for all premium systems *at standard conditions*. Any other basis of comparison would lead to a contradiction.[1]

For the purpose of this article, let us assume the following operating conditions:

Base rate = \$0.50 per hr.; incentive allowance 33 1/3 per cent = 1/3.
Working day = 8 hr.; actual time for the job = 2 hr.
Standard time for the job = 1 hr.

Under these conditions, day wages would be:

Actual: $8 \times \$0.50 = \$4$.
Standard: $(8 \times \$0.50) + 1/3\ (8 \times \$0.50) = \$4 + \$1.33 = \$5.33$.

Direct labor costs for the job would be:

Actual: $2 \times \$0.50 = \$1$.
Standard: $(1 \times \$0.50) + 1/3\ (1 \times \$0.50) = \$0.500 + \$0.167 = \$0.667$.

It may therefore be said that wages at standard conditions on the basis of the assumptions made are \$5.33 per day, and costs per job at standard are \$0.667 for all premium plans.

The premium plans to be considered are the following: (a) 100 per cent Premium; (b) Emerson; (c

[1] For a very interesting exposition of this point, see *Management Engineering*, June 1922, p. 370, "Wage-Payment Plans—A Discussion," by Harrington Emerson.

Bedeaux; (d) Rowan: (e) Halsey 50 per cent; (f) Barth and (g) Gantt. As stated above, these plans are similar in that (1) they are all based on a time standard; and (2) they all pay a certain base rate. The chief difference occurs in (1) the method by which actual performance is related to standard; and (2) the amount of the allowed time, which marks the point at which premium starts.

The *100 per cent premium plan* pays for the actual time worked, plus all the time saved.[2] Expressed in another way, if a man does a job in less than the allowed time, the 100 per cent plan pays an amount equivalent to the product of his base rate and the allowed time.

The *Emerson plan* pays for the actual time worked, plus a percentage bonus depending upon the "Emerson" efficiency, which is found by dividing the allowed time by the actual time. The bonus rate is then found by referring to a table. This rate varies from 25 per cent at 67 per cent efficiency to 20 per cent at 100 per cent "Emerson" efficiency. Above 100 per cent the percentage bonus is the same as the increase in "Emerson" efficiency. For example, 120 per cent efficiency would carry a $20 + 20 = 40$ per cent bonus.

The *Bedeaux system* expresses all relationships in terms of "points". A point represents "the normal amount of energy expended," or from another angle, the normal amount of work due in a minute. Obviously, normal production will be at the rate of 60 points per hr. Incidentally, 60 points per hr. marks the place at which premium starts. If more than 60 points per hr. are produced, the operator receives credit for 60 points, and in addition three-fourths of all points produced over 60. The remaining one-fourth goes into a pool which is apportioned to those on indirect labor, including superintendents, foremen, move men, etc., who are supposed to be responsible for that portion of the increase.

To calculate an operator's earnings, the points allowed are multiplied by the rate per point, which in the case of a \$0.50 per hr. man would be 5/6 cents = \$0.00833 per point. For example, suppose an operator produces 700 points in 8 hr.; he would be allowed the normal production of 60 points per hr. or 480 points, and three-fourths of the surplus of 220 points, or 165 points, making a total of 645 allowed points. His earnings would be $[480 + \frac{3}{4}(700-480)]\ \$0.00833 = 645 \times \$0.00833 = \$5.37$.

The extra 55 points $(700-645)$ would go into a pool which is apportioned to the indirect labor as stated.

The Bedeaux system is very similar to the Halsey 75 per cent plan. As it works out, an operator is paid for the actual time worked, plus three-fourths of the time saved.

The *Rowan system* pays for the actual time, plus a percentage bonus equal to the percentage time saved. Expressed mathematically, the wage is:

$$\left(\text{Actual time} + \left(\frac{\text{Time saved}}{\text{Allowed time}}\right)\text{Actual time}\right)\text{base rate}.$$

Since the premium rate can never be greater than unity, the wage can never exceed twice the base rate.

[2] The time saved is represented by the difference between the allowed time and the actual time. It varies for each system.

The *Halsey 50 per cent system* pays for the actual time, plus one-half of the time saved.

The *Barth system* is quite different from the previous plans described. Under this system the time paid for is represented by the geometrical mean of the actual and allowed time. The wage would be:

$$\sqrt{\text{Actual time} \times \text{allowed time}} \times \text{base rate}$$

The *Gantt system* is similar to the 100 per cent plan, except that the allowed time and the standard time are the same. This follows because under the Gantt system the operator must reach standard before premium is received. The Gantt plan, as will be shown, is similar to the day-work plan below standard and the 100 per cent plan above standard.

In comparing these several premium systems, the basis of comparison must be determined. In this article the job basis is used, but the same conclusions could be reached with any other basis. Using the job basis of comparison we are interested in knowing how costs and wages vary under the different systems as the time varies from, say, 2 hr. to 0.60 hr.

The first step in such a comparison is to calculate the allowed time for each premium system. These calculations are all based on the assumption made, that at standard (job time = 1 hr.), the operator will receive one-third more than his base rate. The calculations follow:

100 per cent Premium:

$$\text{Allowed time} = 1 + \left(1 \times \frac{1}{3}\right) = 1 + 0.33 = 1.33 \text{ hr.}$$

Emerson:

$33\frac{1}{3}$ per cent bonus is given at 113 per cent "Emerson" efficiency.

Allowed time $= 1 \times 1.13 = 1.13$ hr.

Bedeaux:

The object of the calculation for this system is to figure the number of points which must be produced in the standard time (1 hr.) so that the earnings will be one-third more than the normal rate.

Let x = the standard or job points.

a = the rate per point.

$$\text{Then } \left(60 + (x-60)\frac{3}{4}\right) a = \left(\frac{4}{3} a\right) 60.$$

$x = 86.7$ points.

Rowan:

Let y = allowed time.

$$\text{Then } \frac{y-1}{y} = \frac{1}{3}.$$

Solving, $y = 1.50$ hr.

Halsey 50 per cent:

$$\frac{\frac{1}{3}}{0.50 \text{ per cent}} = \frac{2}{3}; \quad \text{Allowed time} = 1 + \left(1 \times \frac{2}{3}\right) = 1 + 0.67 = 1.67 \text{ hr.}$$

Barth:

$$\text{Allowed time} = \left(1 \times \frac{4}{3}\right)^2 = 1.78 \text{ hr.}$$

Gantt:

Allowed time = 1 hr. (by definition).

Now assuming that the time of doing the job varies

from 2 hr. to 0.60 hr., what will be the effect on costs and wages? To illustrate, suppose that the time is 1.15 hr., which probably approximates normal operating conditions, as it is 87 per cent of standard.

The calculations of costs and wages at this point follow:

100 per cent Premium:

$$\text{Cost} = 1.33 \times \$0.50 = \$0.667.$$

$$\text{Wages} = \frac{\$0.667}{1.15} \times 8 = \$4.63.$$

Emerson:

$\frac{1.13}{1.15} = 98.3$ per cent "Emerson" efficiency; bonus rate from the Emerson table = 18.3 per cent.

$$\text{Cost} = (1.15 \times \$0.50) + 0.183(1.15 \times \$0.50) = \$0.575 + \$0.105 = \$0.680.$$

$$\text{Wages} = \frac{\$0.680}{1.15} \times 8 = \$4.73.$$

Bedeaux:

$$\text{Job points} = 86.7; \quad \text{point hr.} = \frac{86.7}{1.15} = 75.3; \quad \text{rate per point} = \$0.00833.$$

$$\text{Cost (direct labor)} = \left\{ 60 + (75.3 - 60)\frac{3}{4} \right\} \frac{1.15}{1} \times \$0.00833 = \$0.685$$

$$\text{Cost (pool)} = \left\{ (75.3 - 60)\frac{1}{4} \right\} \frac{1.15}{1} \times \$0.00833 = \$0.037$$

$$\text{Total cost} = 86.7 \times \$0.00833 = \$0.722 \quad (\text{or } \$0.685 + \$0.037 = \$0.722)$$

$$\text{Wages (direct labor)} = \frac{\$0.686}{1.15} \times 8 = \$4.76$$

$$= \left\{ \left((75.3 \times 8) - (60 \times 8) \right) \frac{3}{4} + 480 \right\} \$0.00833 = \$4.76$$

$$\text{Pool premium (8 hr.)} = \frac{\$0.037}{1.15} \times 8 = \$0.25$$

$$= \left\{ \left((75.3 \times 8) - (60 \times 8) \right) \frac{1}{4} \right\} \$0.00833 = \$0.25$$

Rowan:

$$\text{Cost} = (1.15 \times \$0.50) + \left(\frac{1.50 - 1.15}{1.50} \right) (1.15 \times \$0.50) = (1.15 \times \$0.50)\ 1.23 = \$0.709$$

$$\text{Wages} = \frac{\$0.709}{1.15} \times 8 = \$4.93$$

Halsey 50 per cent:

$$\text{Cost} = (1.15 \times \$0.50) + \left(\frac{1.67 - 1.15}{2} \right) \$0.50 = \$0.575 + \$0.130 = \$0.705$$

$$\text{Wages} = \frac{\$0.705}{1.15} \times 8 = \$4.90$$

Barth:

$$\text{Cost} = \$0.50 \sqrt{1.15 \times 1.78} = \$0.715$$

$$\text{Wages} = \frac{\$0.715}{1.15} \times 8 = \$4.97$$

Gantt[3]*:*

$$\text{Cost} = 1.15 \times \$0.50 = \$.575$$

$$\text{Wages} = \frac{\$0.575}{1.15} \times 8 = \$4$$

The summarized calculations for each wage system showing the variation in costs and wages, as the job time varies, are shown in Tables 1 to 6. These data plotted as wage curves are shown in Figs. 1 and 2.

Referring to Fig. 1, the line XYZ represents the day-work line, which is approximated by the curves of the various premium plans. From Fig. 2, it will be seen that the day-work wage is constant at $4 regardless of the time taken for the job. This condition is theoretical and ideal because it is necessary in practice, as stated above, to give an incentive to the operator as a reward for the extra effort he is compelled to make in reducing the time required for the job. It would therefore be out of the question to expect a man to reduce his actual time from 2 hr. to a standard time of 1 hr. without some extra recompense, especially if the decreased time is due in considerable measure to his

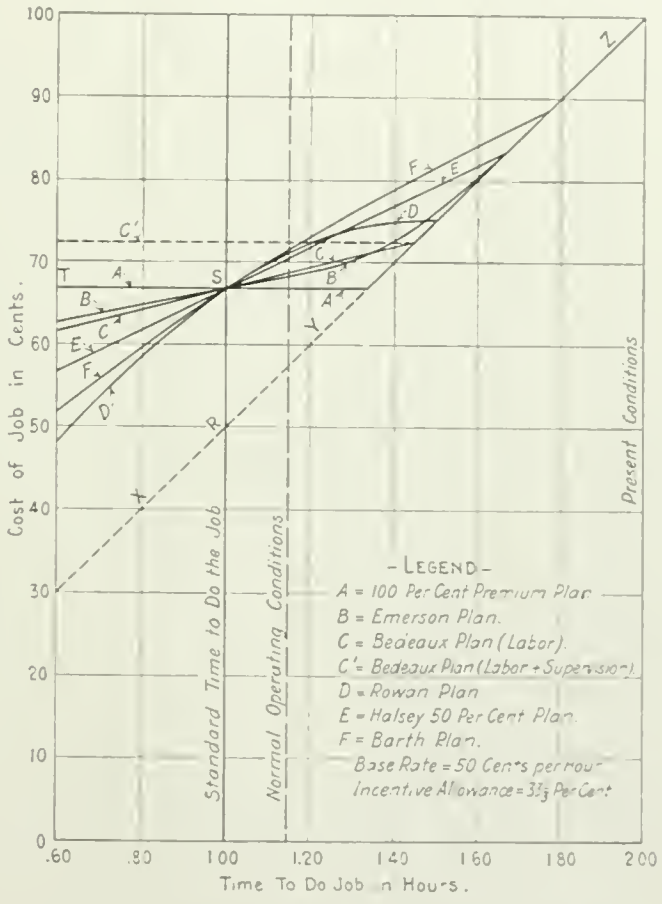
Cost of Job in Cents.
Time To Do Job in Hours.
Standard Time to Do the Job
Normal Operating Conditions
Present Conditions
- LEGEND -
A = 100 Per Cent Premium Plan.
B = Emerson Plan.
C = Bedeaux Plan (Labor).
C' = Bedeaux Plan (Labor + Supervision).
D = Rowan Plan.
E = Halsey 50 Per Cent Plan.
F = Barth Plan.
Base Rate = 50 Cents per hour.
Incentive Allowance = 33⅓ Per Cent.

FIG. 1 WAGE CHART SHOWING VARIATION IN COST OF THE JOB

own efforts. Therefore, the XYZ line may be assumed as ideal, and for the purpose of this article, serves only to show how closely the premium plans considered approach this ideal.

Some of the conclusions shown by the tabulations and curves are:

1. At normal operating conditions of between 85 and 90 per cent of standard (shown on the charts at a job time of 1.15 hr.) there is no very great difference between the various wage plans on costs, Fig. 1, and wages, Fig. 2. Labor costs vary from $0.667 (100 per cent Premium) to $0.715 (Barth), and wages vary from $4.63 (100 per cent Premium) to $4.97 (Barth), a spread of 7.2 per cent. While this difference would

[3] As already stated, no premium is received until standard is attained, under this plan.

probably amount to a considerable sum over a long period of time, it is not so great as to preclude a consideration of other factors which must be taken into account in selecting a proper wage plan. Some of these factors will be mentioned later in the consideration of each system.

2. The wage plans which apparently give the operator the least, in reality give him the most compensation for the same effort. This can be demonstrated by observing the trend of curves A, C and E on Fig. 2. These curves represent the 100 per cent premium (Halsey 100 per cent), Bedeaux (Halsey 75 per cent) and Halsey 50 per cent plans. The 100 per cent Premium plan gives the operator all the time that he saves, the Bedeaux three-fourths, and the Halsey

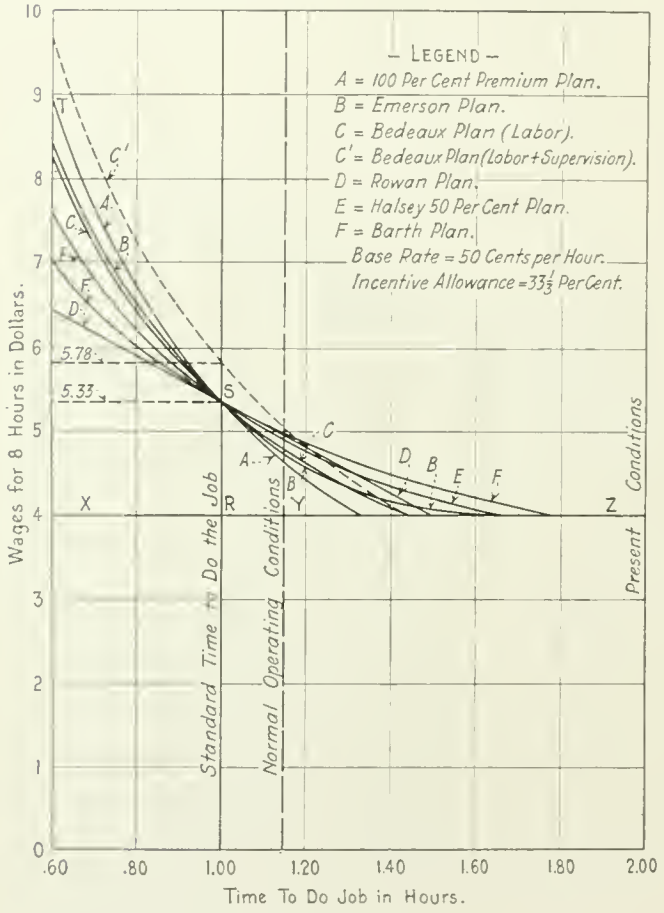

FIG. 2 WAGE CHART SHOWING VARIATION IN WAGES FOR 8 HR.

50 per cent, one-half of the time saved. Apparently the 100 per cent plan is the more liberal, but an examination of the curves at a job time of say 1.20 hr. shows wages of $4.44 (100 per cent Premium), $4.61 Bedeaux), and $4.78 (Halsey 50 per cent). The explanation for this apparent contradiction lies in the fact that as the percentage premium allowance increases, the allowed time, that is the point at which the premium starts, decreases. For example, the allowed time of the Halsey 50 per cent is 1.67 hr., the Bedeaux (Halsey 75 per cent) 1.44, the 100 per cent Premium plan 1.33 hr. It is apparent, therefore, that under the 100 per cent plan, the time must be reduced more than under the other systems before premium starts. This also explains the fact that the plan which apparently costs the most (100 per cent Premium) in reality costs the least for the same job time.

The relative advantages and disadvantages of each plan may be summarized as follows:

(*a*) 100 per cent Premium Plan

1. This plan, since it follows the day-work line the longest and since it has the lowest allowed time, results in the greatest decrease of costs of any of the premium plans.

TABLE 1. 100 PER CENT PREMIUM PLAN
(Allowed time = 1.333 hr.)

*(1) Job Time (Hr.)	(2) *(1)×$0.50 Day-Work Wage (Dollars)	(3) 1.333–(1) Time Saved (Hr.)	(4) (3)×$0.50 Premium (Dollars)	(5) (2)+(4) Labor Cost (Dollars)	(6) $\frac{(5)}{(1)}\times 8$ hr. 8 Hr. Wages (Dollars)
0.50	0.250	0.833	0.417	0.667	10.67
0.60	0.300	0.733	0.367	0.667	8.89
0.70	0.350	0.633	0.317	0.667	7.61
0.80	0.400	0.533	0.267	0.667	6.67
0.90	0.450	0.433	0.217	0.667	5.92
1.00	0.500	0.333	0.167	0.667	5.33
1.10	0.550	0.233	0.117	0.667	4.85
1.20	0.600	0.133	0.067	0.667	4.44
1.30	0.650	0.033	0.017	0.667	4.11
1.40	0.700	....	....	0.700	4.00
1.50	0.750	....	....	0.750	4.00
1.60	0.800	....	....	0.800	4.00
1.70	0.850	....	....	0.850	4.00
1.80	0.900	....	....	0.900	4.00
1.90	0.950	....	....	0.950	4.00
2.00	1.000	....	....	1.000	4.00

*Numbers in parentheses indicate columns.

TABLE 2. EMERSON PLAN
(Allowed time = 1.133 hr.)

(1)* Job Time (Hr.)	(2) *(1)×$0.50 Day-Work Wage (Dollars)	(3) $\frac{1.133}{(1)}$ "Emerson" Efficiency (Per Cent)	(4) From Table Bonus Rate (Per Cent)	(5) (2)×(4) Premium (Dollars)	(6) (2)+(5) Labor Cost (Dollars)	(7) $\frac{(6)}{(1)}\times 8$ hr. 8 Hr. Wages (Dollars)
0.50	0.250	226	146	0.367	0.617	9.86
0.60	0.300	188	108	0.327	0.627	8.36
0.70	0.350	162	82	0.287	0.637	7.27
0.80	0.400	141	61	0.247	0.647	6.47
0.90	0.450	126	46	0.207	0.657	5.83
1.00	0.500	113	33	0.167	0.667	5.33
1.10	0.550	103	23	0.127	0.677	4.92
1.20	0.600	94.2	14.2	0.085	0.685	4.58
1.30	0.650	86.9	8.0	0.052	0.702	4.32
1.40	0.700	80.9	4.3	0.030	0.730	4.17
1.50	0.750	75.6	1.9	0.014	0.764	4.07
1.60	0.800	70.8	0.4	0.003	0.803	4.03
1.70	0.850	66.7	....	....	0.850	4.00
1.80	0.900	62.8	....	....	0.900	4.00
1.90	0.950	59.7	....	....	0.950	4.00
2.00	1.000	56.7	....	....	1.000	4.00

*Numbers in parentheses indicate columns.

2. It is probably the best, as far as the psychological effect on the operators is concerned, because it is *apparently* more remunerative than any of the other systems.
3. It is the simplest for the operator to understand. To figure earnings, simply multiply the allowed time by the base rate.
4. On account of the fact that it is so simple to calculate earnings, it requires less clerical work to operate than the other plans.
5. Under normal conditions, it results in constant labor costs which is of particular value to the management in predetermining costs.
6. The spread between the high and low performance man is high. This may or may not be an advantage depending on conditions. Ordinarily a high spread is a good thing since it rewards and encourages exceptional performance. However, situations are conceivable where it would be desirable to have a low spread,

in which case the 100 per cent plan would be at a disadvantage.

7. Under the 100 per cent plan the operator must decrease his time 33 per cent before he starts to receive a premium. With the exception of the Gantt, this is the highest task of any of the premium systems and, as such, is apt to discourage the low performance man who is started on premium very much earlier under other plans.
8. On Fig. 2, it will be noted that the 100 per cent curve has a very steep slope above standard. This indicates that a 100 per cent Premium operator will very easily make excessive earnings if he happens to be working on a rate which has been improperly set. This danger is averted by the Rowan and Barth plans as will be explained later.

(*b*) Emerson Plan

1. This system is perhaps nearest, at least in theory, to the ideal wage plan. It starts a man on premium at a relatively low increase in efficiency (15 per cent) and at the same time rewards exceptional performance by a constantly increasing premium.
2. Next to the 100 per cent plan, it is the cheapest system at normal conditions. At a job time of 1.15 hr. the labor costs are about 2 per cent more than on the 100 per cent plan.
3. It is difficult for the ordinary operator to understand. To figure earnings it is necessary to calculate "Emerson" efficiency and then refer to a bonus table from which the bonus rate is found.
4. Due to its complexity, it requires more clerical work than the 100 per cent plan to maintain.
5. It results in varying labor costs, a disadvantage from a cost standpoint.

(*c*) Bedeaux Plan

1. This system through the supervision bonus or pool, provides an incentive for greater production to those on indirect labor. The tendency of the pool, obviously, is to assure better co-operation between the direct and indirect labor and to increase the efficiency of all who participate in the pool.[4]

Objection might be made to the pool on the ground that it is paying twice for the same work. Another objection that may be seriously considered is that the Bedeaux arrangement would in certain cases endanger quality of workmanship.

2. The Bedeaux system with the "point" feature enjoys the advantage of novelty and uniqueness.
3. Allowing for the supervision bonus, this system at the normal conditions assumed for this article (job time 1.15 hr.) is about 8.4 per cent more expensive than the 100 per cent plan; excluding the supervision bonus it is about 2.8 per cent more expensive.
4. It has a high incentive requiring an increase in efficiency of 28 per cent before premium is received.
5. It requires considerable clerical work to figure earnings and costs.
6. It is fairly easy to understand.
7. Including the supervision bonus, it results in constant costs but about 8.4 per cent higher than the 100 per cent plan, as already stated.

TABLE 3. BEDEAUX PLAN

Normal = 60 points per hr.; r = rate per point = $0.00833

*(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Job Time (Hr.)	Job Points	(2) ÷ 1 Point Hr. Points per Hr.	(3)−60 Points Saved	¾ × (4) ¾ Points Saved	(5) + 60 Labor Point Hr. Points per Hr.	6 × r Wages 1 Hr. Dollars	7 × 8 Wages 8 Hr. Dollars	¼ × (4) ¼ Points Saved	(9) × r Pool Premium 1 Hr. Dollars	10 × 8 Pool Premium 8 Hr. Dollars	8 + 11 Total Wages and Pool 8 Hr. Dollars	7 × 1 Labor Cost of Job Dollars	10 × 1 Pool Cost of Job Dollars	13 + 14 Total Cost of Job Dollars
0.50	86.7	173.3	113.3	85.0	145.0	1.208	9.66	28.3	0.236	1.89	11.55	0.604	0.118	0.722
0.60	86.7	144.4	84.4	63.3	123.3	1.028	8.22	21.1	0.176	1.41	9.63	0.617	0.105	0.722
0.70	86.7	123.8	63.8	47.9	107.9	0.898	7.18	15.9	0.132	1.06	8.24	0.629	0.093	0.722
0.80	86.7	108.3	48.3	36.2	96.2	0.801	6.41	12.1	0.101	0.81	7.22	0.641	0.081	0.722
0.90	86.7	96.2	36.2	27.1	87.1	0.726	5.81	9.1	0.076	0.61	6.42	0.653	0.069	0.722
1.00	86.7	86.7	26.7	20.0	80.0	0.667	5.33	6.7	0.055	0.45	5.78	0.667	0.055	0.722
1.10	86.7	78.8	18.8	14.1	74.1	0.617	4.94	4.7	0.039	0.31	5.25	0.679	0.043	0.722
1.20	86.7	72.3	12.3	9.2	69.2	0.576	4.61	3.1	0.026	0.21	4.82	0.691	0.031	0.722
1.30	86.7	66.7	6.7	5.0	65.0	0.542	4.33	1.7	0.014	0.11	4.44	0.704	0.018	0.722
1.40	86.7	61.9	1.9	1.4	61.4	0.512	4.09	0.5	0.004	0.03	4.12	0.717	0.005	0.722
1.50	86.7	57.8	...	..	57.8	0.500	4.00	...	.	..	4.00	0.750	..	0.750
1.60	86.7	54.2	.	..	54.2	0.500	4.00	...	..	...	4.00	0.800	...	0.800
1.70	86.7	51.0	...	..	51.0	0.500	4.00	...	...	...	4.00	0.850	...	0.850
1.80	86.7	48.2	...	...	48.2	0.500	4.00	...	..	..	4.00	0.900	.	0.900
1.90	86.7	45.6	...	...	45.6	0.500	4.00	...	...	...	4.00	0.950	...	0.950
2.00	86.7	43.3	...	...	45.3	0.500	4.00	...	...	...	4.00	1.000	..	1.000

*Numbers in parentheses indicate columns.

(*d*) Rowan Plan

1. The leading feature of this system is that the limit of earnings is fixed at twice the base rate. This is taken care of by calculating the premium as a percentage of the day-work wage and is represented by the following ratio:

$$\frac{\text{Allowed time—Actual time}}{\text{Allowed time}}$$

It is clear that the limit of this ratio is one and therefore the earnings cannot exceed twice the base rate. This feature has led many firms to adopt this system as it serves as a protection against faulty rate-setting.

2. Due to the self-checking feature it penalizes exceptional performance. Reference to Table 4 shows that under the above standard (job time 0.70 hr.) the premium actually decreases. Under normal conditions, however, it is very lenient and at this point it is next to the Barth the most expensive.
3. It is very difficult to understand and figure earnings.
4. It results in varying costs.

(*e*) Halsey 50 per cent Plan

1. This system starts the operator on premium very early

[4] It will be remembered that one-quarter of all the points produced above 60 per hr., go into a pool which is divided up among the superintendent, foremen, move men, and others responsible indirectly for increased production.

(16.7 per cent increase of efficiency) in his approach to standard conditions; and is consequently expensive in its earlier stages. At normal conditions, however, it is about midway between the two extremes in both costs and wages. (5.7 per cent higher than the 100 per cent plan.)

2. It results in a small spread between the high and low performance man.
3. Next to the 100 per cent plan, it is the simplest to figure earnings and costs.
4. It results in varying costs.

(*f*) Barth Plan

1. This plan has a novel method of figuring earnings based on the geometrical mean of the actual and the allowed time. This plan, like the Rowan, limits the earnings as the job time decreases; but an examination of the curves shows that it has a more sweeping range than the Rowan, and furthermore does not repress superior performance but gives a constantly increasing premium as the job time decreases. (See Table 6).

TABLE 4. ROWAN PLAN
Allowed time = 1.500 hr.

*(1) Job Saved (Hr.)	(2) *(1)×$0.50 Day-Work Wage (Dollars)	(3) 1.500−(1) Time Saved (Hr.)	(4) (3)/1.500 Time Saved (Per Cent)	(5) (4)×(2) Premium (Dollars)	(6) (5)+(2) Labor Cost (Dollars)	(7) (6)/(1)×8 hr. 8 Hr. Wages (Dollars)
0.50	0.250	1.000	66.7	0.167	0.417	6.67
0.60	0.300	0.900	60.0	0.180	0.480	6.40
0.70	0.350	0.800	53.3	0.187	0.537	6.14
0.80	0.400	0.700	46.7	0.187	0.587	5.87
0.90	0.450	0.600	40.0	0.180	0.630	5.60
1.00	0.500	0.500	33.3	0.167	0.667	5.33
1.10	0.550	0.400	26.7	0.147	0.697	5.07
1.20	0.600	0.300	20.0	0.120	0.720	4.80
1.30	0.650	0.200	13.3	0.086	0.736	4.53
1.40	0.700	0.100	6.7	0.047	0.747	4.27
1.50	0.750	....	....	....	0.750	4.00
1.60	0.800	....	....	....	0.800	4.00
1.70	0.850	....	....	....	0.850	4.00
1.80	0.900	....	....	....	0.900	4.00
1.90	0.950	....	....	....	0.950	4.00
2.00	1.000	....	....	....	1.000	4.00

*Numbers in parentheses indicate columns.

2. It starts an operator on premium the earliest of any of the systems (11 per cent increase of efficiency) and is consequently the most expensive plan. At normal conditions, the cost is about 7.2 per cent higher than the 100 per cent plan.
3. It results in a very low spread between the high and low performance man.
4. It is very difficult to understand and figure earnings.
5. It results in varying costs.

(*g*) Gantt Plan

1. This system requires the operator to reach standard conditions before he receives any premium. Below standard, he receives the day-work wage and at standard he is given a premium of one-third (for the conditions of this article) and from that point on receives the same compensation as is given by the 100 per cent Premium plan. The curve for the Gantt plan is represented by ZRST (see Figs. 1 and 2).
2. For the conditions assumed in this article, it is questionable whether the Gantt plan would be practicable. It would require an operator to reduce his time from 2 hr. to 1 hr., that is, increase his efficiency 50 per cent before giving him any premium. And the Gantt plan is very harsh in that a man must be 100 per cent efficient before he receives a premium. At 99 per cent he would receive only his day-work wage and at standard he would be abruptly raised one-third. It is apparent that such a high task would act as a deterrent to a slow operator who would not be willing to make extra effort at the risk of not receiving any premium for that effort. This situation is handled admirably on the Emerson plan, as stated above, by starting the low operator on a small premium very early, and by gradually increasing the premium, thus furnishing a constant incentive and reward for increased efficiency.

TABLE 5. HALSEY 50 PER CENT PLAN
Allowed time = 1.667 hr.

*(1) Job Time (Hr.)	(2) *(1)×$0.50 Day-Work Wage (Dollars)	(3) 1.667−(1) Time Saved (Hr.)	(4) (3)×½ Time Saved (Hr.)	(5) (4)×$0.50 Premium (Dollars)	(6) (5)+(2) Labor Cost (Dollars)	(7) (6)/(1)×8 hr. 8 Hr. Wages (Dollars)
0.50	0.250	1.167	0.583	0.292	0.542	8.67
0.60	0.300	1.067	0.533	0.267	0.567	7.56
0.70	0.350	0.967	0.483	0.242	0.592	6.76
0.80	0.400	0.867	0.433	0.217	0.617	6.17
0.90	0.450	0.767	0.383	0.192	0.642	5.70
1.00	0.500	0.667	0.333	0.167	0.667	5.33
1.10	0.550	0.567	0.283	0.142	0.692	5.03
1.20	0.600	0.467	0.233	0.117	0.717	4.78
1.30	0.650	0.367	0.183	0.092	0.742	4.57
1.40	0.700	0.267	0.133	0.067	0.767	4.38
1.50	0.750	0.167	0.083	0.042	0.792	4.22
1.60	0.800	0.067	0.033	0.017	0.817	4.08
1.70	0.850	....	....	....	0.850	4.00
1.80	0.900	....	....	....	0.900	4.00
1.90	0.950	....	....	....	0.950	4.00
2.00	1.000	....	....	....	1.000	4.00

*Numbers in parentheses indicate columns.

TABLE 6. BARTH PLAN
Allowed time = 1.778 hr. = t

*(1) Job Time (Hr.)	(2) $\sqrt{t\times(1)}$ "Barth" Time (Hr.)	(3) *(2)×$0.50 Labor Cost (Dollars)	(4) (1)×$0.50 Day-Work Wage (Dollars)	(5) (3)−(4) Premium (Dollars)	(6) (5)/(1)×8 hr. 8 Hr. Wages (Dollars)
0.50	0.944	0.472	0.250	0.222	7.55
0.60	1.033	0.517	0.300	0.217	6.89
0.70	1.118	0.559	0.350	0.209	6.39
0.80	1.193	0.596	0.400	0.196	5.96
0.90	1.267	0.633	0.450	0.183	5.63
1.00	1.333	0.667	0.500	0.167	5.33
1.10	1.400	0.700	0.550	0.150	5.09
1.20	1.462	0.731	0.600	0.131	4.88
1.30	1.521	0.760	0.650	0.110	4.68
1.40	1.579	0.789	0.700	0.089	4.51
1.50	1.634	0.817	0.750	0.067	4.36
1.60	1.690	0.845	0.800	0.045	4.22
1.70	1.740	0.870	0.850	0.020	4.09
1.80	1.790	0.900	0.900	....	4.00
1.90	1.840	0.950	0.950	....	4.00
2.00	1.888	1.000	1.000	....	4.00

*Numbers in parentheses indicate columns.

However, the Gantt plan has a place in industry and is perhaps best adapted to a situation where the task is comparatively low, for instance in a rather efficient plant, where the incentive allowance would be small, say, 10 per cent. In this case, the low performance man would not have far to go to reach standard, and the abruptness of the increase at standard would be lessened. In such a situation the Gantt plan would have all the advantages characteristic of the day-work and 100 per cent plans.

In conclusion, the writer believes that each premium system has certain features and selling points which recommend it for a definite situation. It cannot be said with fairness, that any one wage system is best for *all* possible conditions. Each case must be decided individually and the wage plan should be selected which is best adaptable to the conditions.

Charts for Report Purposes

By H. N. STRONCK

Industrial Engineer, Arthur Andersen & Co.

Index Number
658.532 Production charts
621.753 Chart making

THE rapid growth of the market for industrial and public utility investment securities has created a demand for the critical analysis of the value of such securities among investment bankers. The originators of such new investment securities usually purchase the entire issue with their own funds at a wholesale price and then sell them to the general public. One of the prime considerations in the purchase of an investment security is safety of the principal and stability of the income.

In order to determine this, it is necessary to obtain considerably more information as a basis for an analysis and conclusion, than is possible from the ordinary balance sheet, profit and loss statement, and valuation of the physical properties. Such an analysis may be termed a "commercial analysis," and the resultant report covers such phases as sales, markets, organization, personnel, results from operations, position in the industry, systems and methods of operating, trends and tendencies and, in fact, all such phases of the business as might affect the future earnings or influence the payment of interest or dividends and the retirement of the prineipal.

Due to the variety of subjects covered by such a report and the necessity of a detailed analysis of the subject matter so that definite conclusions can be drawn, it becomes necessary to adopt various means of visualizing the information, and for studying the tendencies in order to accomplish this, various methods of graphic representation are used.

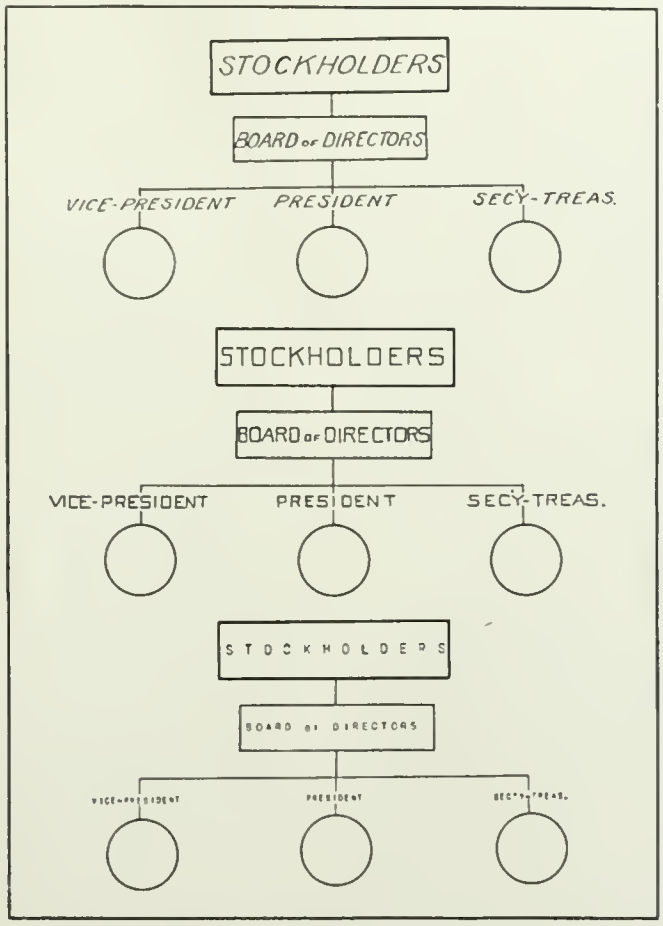

FIG. 1 CHART SHOWING VARIOUS TYPES OF LETTERING

Advantage of Graphic Representations

In the final analysis the most important part of such a commercial or business survey report is the summary and conclusions. Since the summary and conclusions are based on specific information and data, it is obvious that all reports are identical, in a broad way, as to the data and information should be presented in such a form that the reader of the report can quickly visualize the situation and understand and confirm the conclusions drawn. A report of this kind must be thorough and complete, but at the same time should be limited as to text. Were it not possible to convey the information and data in a condensed manner, such as through graphic charts, the average report of this kind would become extremely bulky in text matter, and one of the essential features, that of quickly and clearly picturing the situation to a third party, would be lost.

When facts are presented for consideration in graphic form, the whole view of conditions is seen at once. If columns of figures are looked at, the eye sees and the mind grasps only one point at a time. Not only is ease of comprehension gained by this method, but the benefit that comes from getting a perspective is also obtained. Many of the conclusions drawn are based upon a study and analysis of data, and graphic representations more quickly and clearly indicate trends and variations than any other method. The shape of a curve gives a picture of the trend without the necessity of translating figures. Variations from normal are quickly detected, the reasons therefor analyzed, and the future effect thereof studied.

A business survey report must not only be technically correct in its data, analysis, and conclusions, but the make-up of the report should show a high grade of workmanship, neatness, and logic of sequence of compilations. It, therefore, becomes necessary to study the best methods of make-up and to determine standards so that no variations occur within the same report and

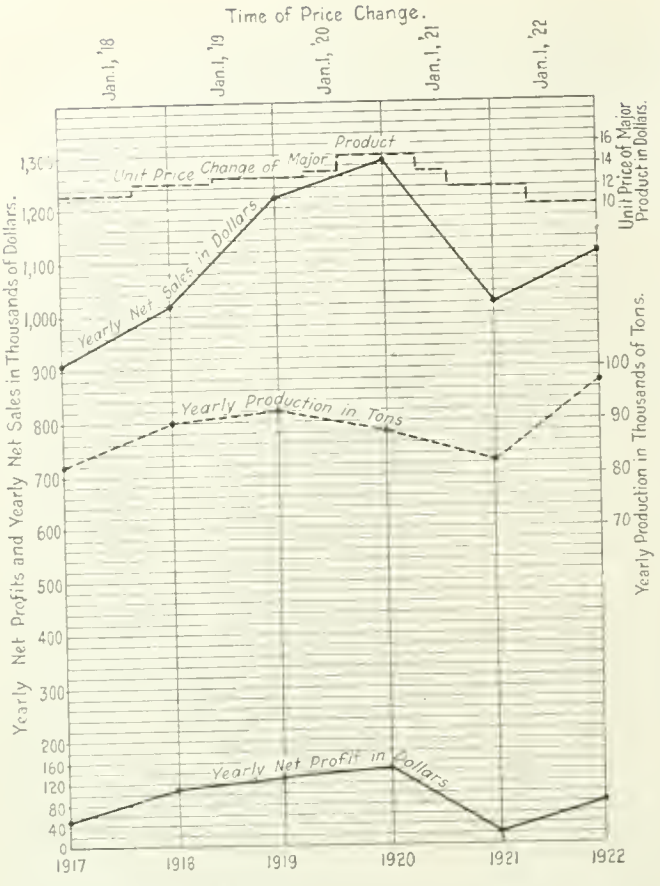

FIG. 2 TYPICAL LINE CHART OF THE SIMPLEST FORM SHOWING A COMPARISON BY YEARS OF NET SALES IN DOLLARS, PRODUCTION IN TONS, NET PROFITS IN DOLLARS AND UNIT PRICE CHANGES OF MAJOR PRODUCT

technical make-up of drawings, charts, tables, and arrangements of text and exhibits.

A most convenient size for such a report is 9 x 12 in. By adopting this as the standard size, all charts and illustrations must be drawn or reproduced to a size which will directly fit the 9 x 12 in. dimension, or multiples thereof for folding purposes. The drawing part of each chart is surrounded by a heavy border line. A margin of at least one inch is always maintained between the left border line and the edge of the sheet, for binding purposes. A margin of at least one-half inch is always maintained between the right, top, and bottom border lines and their respective edges. The maximum full-sized chart, therefore, between border lines, is 7½ x 11 in.

Treatment of Large Charts

The majority of charts in such a report fall within this size and all are drawn and reproduced full size. However, the usual report contains some charts, such as those of the present, and proposed forms of organization, flow sheets, etc., which are of such a size as to make it impossible to draw them to a scale which, when reproduced, will be of this size and still be legible. Whenever it is possible, these large charts are laid out in such a manner that they will spread out horizontally so that it will not be necessary for the reader to turn the report. These charts will consist of one or more folds. The maximum vertical dimension will be the same as for the single page charts, that is, an outside vertical dimension of 12 in. and 11 in. within borders. So that the fold will not conflict with the binding space, the maximum outside horizontal dimension of the single fold chart is 17 in., and the within border dimension is 15½ in. Similarly, for the two-fold chart, these dimensions will be 25 in. and 23½ in., respectively.

Reproductions of Charts

No doubt the majority of all engineering and design drawings are reproduced by the contact print method, the most popular one being the ordinary blue-print which shows white lines on a blue background. The brown prints are similar but the background is brown. Black line, blue line, and brown line prints are also used, showing black, blue, or brown lines on a white background. The original drawings for such reproductions must be made on translucent material, or after

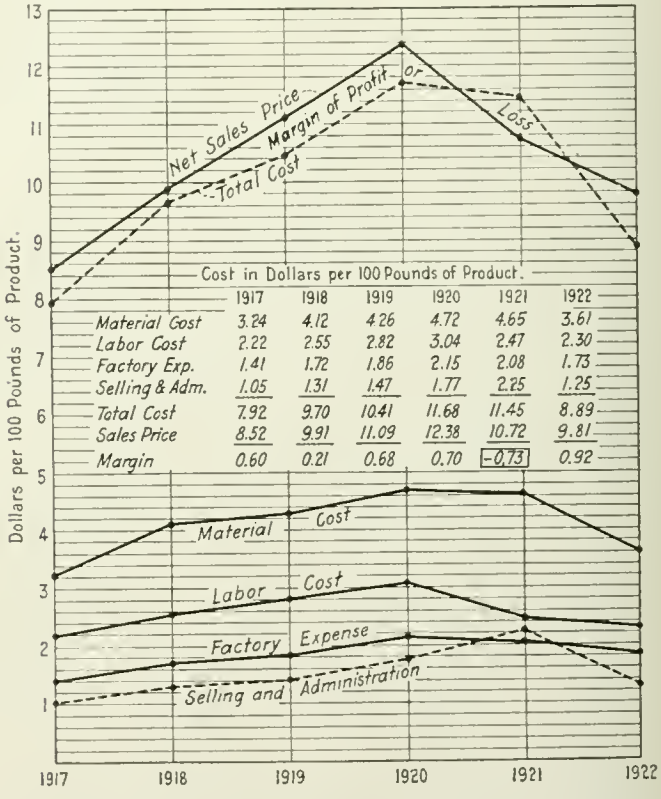
Net Sales Price
Margin of Profit or Loss
Total Cost
Cost in Dollars per 100 Pounds of Product.
Dollars per 100 Pounds of Product.
Material Cost
Labor Cost
Factory Exp.
Selling & Adm.
Total Cost
Sales Price
Margin
1917 1918 1919 1920 1921 1922
3.24 4.12 4.26 4.72 4.65 3.61
2.22 2.55 2.82 3.04 2.47 2.30
1.41 1.72 1.86 2.15 2.08 1.73
1.05 1.31 1.47 1.77 2.25 1.25
7.92 9.70 10.41 11.68 11.45 8.89
8.52 9.91 11.09 12.38 10.72 9.81
0.60 0.21 0.68 0.70 -0.73 0.92
Material Cost
Labor Cost
Factory Expense
Selling and Administration

FIG. 3 TYPICAL LINE CHART AND A STATISTICAL EXHIBIT, SHOWING THE COMPARISON OF UNIT COSTS AND NET SALES PRICES IN DOLLARS PER 100 POUNDS

Note that the trend and relationship of factors may be much more readily seen from the graphic representation than from the statistical.

the drawing is made the material must be treated to make it translucent. All of the reproductions are of the same size as the originals.

About the only advantage such types of reproductions have is low cost of prints, and since this is not to be given much consideration in the make-up of a high-grade report, these methods have been replaced by the photostat method. One of the most important advantages of the photostat method is the possibility in the

reproducing process, of reducing or enlarging the original. This gives the designer considerable flexibility in the layout and design of the charts and drawings. Since reduced size reproductions have the same proportion of effect on the vertical and horizontal dimensions, all that is necessary is the correct proportioning of the original so that any reproduction made will conform with the report size.

Many of the charts used in this type of a report are of such a nature that it would be physically impossible for the designer to make the original small enough for full-sized reproductions and conform to the standard report sizes. However, due to the reduction feature of the photostat process, reductions to one-half, or even in some cases to one-third size, can be made and the resultant print still be legible.

Photostat Reproduction of Special Material

At times it is necessary to include in these reports, charts, drawings, or special illustrations not produced by the examining engineers. Such material is of varied size and make-up, but by means of the photostat process all of this material can be enlarged or reduced and the resultant prints be of standard report size. It will be noted that this process reduces or enlarges the horizontal and vertical dimensions in the same proportion. If, for example, an original with a vertical dimension of 15 in. is to be used in the report, this dimension will need to be reproduced to 11 in. within the border and a trimming paper edge allowance of one-half inch on the top and bottom. This is a reduction of approxi-

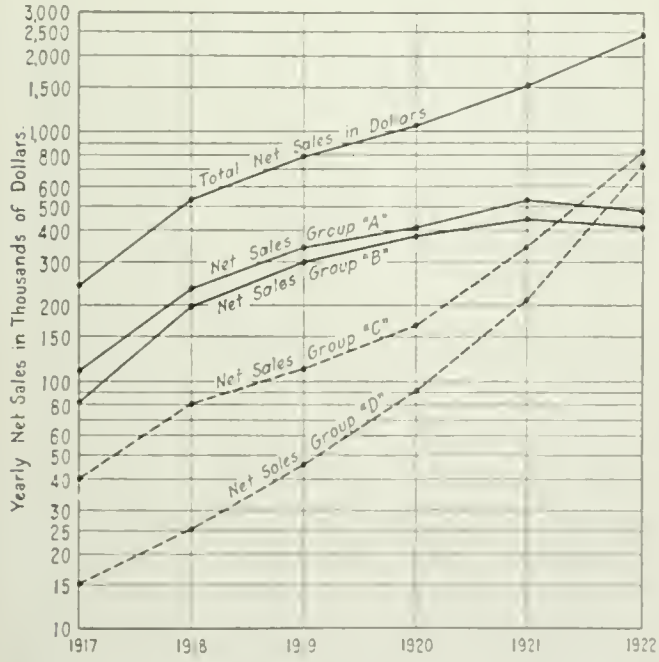

FIG. 4 ANOTHER TYPE OF SIMPLE LINE CHART SHOWING A COMPARISON, BY YEARS, OF NET SALES BY GROUPS, IN DOLLARS, AND YEARLY TOTAL NET SALES IN DOLLARS

mately 27 per cent, and hence the horizontal dimension of the original will also be shortened by 27 per cent.

The graphic charts used for these reports consist, to a large extent, of straight lines and circles requiring very little drafting technique. The time consumed in

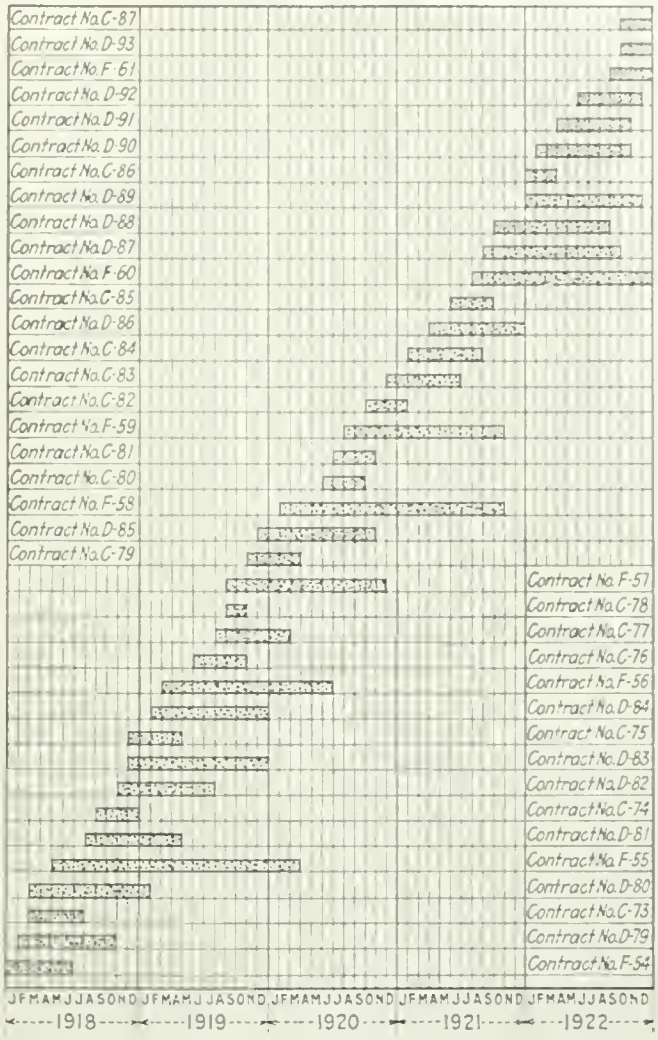

FIG. 5 A REPRESENTATIVE BAR CHART SHOWING A COMPARISON BY MONTHS OF TIME PERIODS OF VARIOUS CONTRACTS

the line work is small. However, a considerable amount of lettering is involved and unless a rapid method of lettering, which at the same time has a high degree of neatness, is used, the time necessary to prepare such charts will be unusually long.

Lettering of Charts

For rapid hand-lettering, the average engineer and draftsman have been trained in and use the sloping, simple, gothic letters. In view of the fact that the drawn lines on the charts are basically either horizontal or vertical, this sloping type of lettering detracts from the appearance of the chart. Vertical free-hand lettering is not quite as rapid, but would add more to the appearance. Where many different charts are used in the same report it often becomes necessary to distribute the work among several persons, and although they would all use the same style of letters there would be a noticeable difference in the executions and the charts would not have the same appearance. T-square and triangle lettering would be fairly uniform; however, the time involved would be far too great. Gummed letters are of use for large titles and headings, but cannot be used conveniently for large amounts of small lettering.

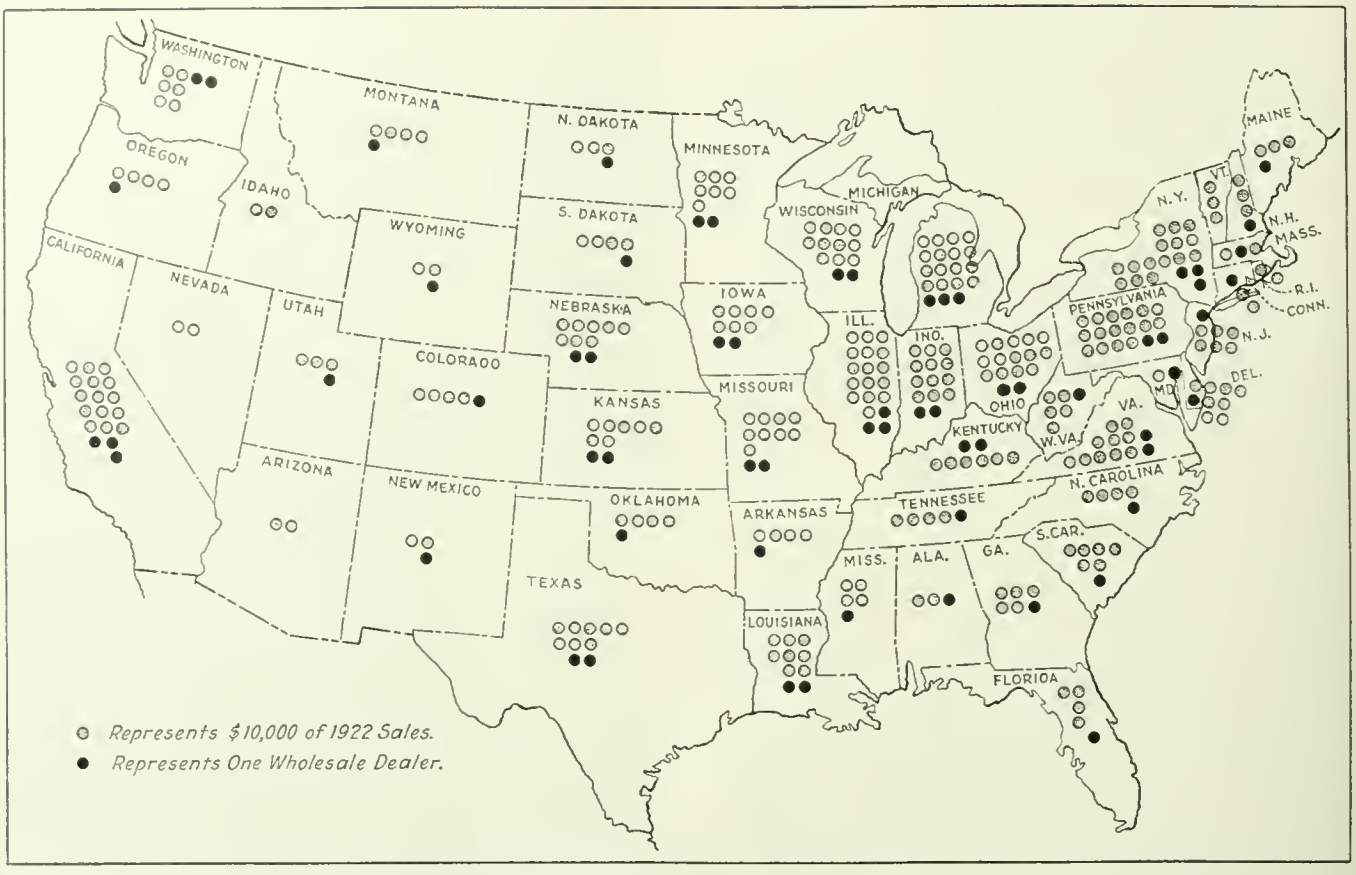

FIG. 6 A TYPICAL GEOGRAPHICAL CHART SHOWING THE DISTRIBUTION OF 1922 SALES IN DOLLARS AND OF WHOLESALE DEALERS IN THE UNITED STATES

For all practical purposes machine lettering is the best because of the speed and uniformity of execution. The commercial typewriter, however, is not adapted for this purpose. The letters on such machines are generally of the Roman style, which style does not blend with the drafting on the chart. The type should be gothic and there must be an arrangement whereby the size of the type can be quickly changed, for the average chart has from three to four different sizes of letters. A means also must be provided for rapidly changing the spacing between letters, for on some parts of the chart 10 letters to the inch are used while on others it is necessary to use 15 or even 18. The carriage design must be of such a nature as to permit the typing on paper of practically any length. It is not unusual to have charts 10 ft. long. None of this work can be done on the ordinary commercial typewriter. However, there are machines on the market which have all of the above features, and it is this type of machine which is used for practically all of the lettering work.

Fig. 1 indicates the contrast between the various methods of lettering. The upper illustration shows the inclined type of lettering, and the middle one a vertical style. The bottom illustration shows machine lettering, with three different sizes of type and three different spacings, performed without removing the paper from the machine.

The majority of the charts used for visualizing past performance, the present situation, and the future trend are line charts of the ordinary type of plain ruling or of logarithmic ruling depending upon whether or not numerical differences or per cent variations are to be shown. Organization charts of present and proposed organization plans are combinations of lines and circles and are classed as line charts. Bar charts are less frequent, but are used where comparisons with intervals of time are necessary. Geographic charts are frequently used, and are ideal for analyzing sales and marketing conditions and problems. The circle chart is not used to any extent because other types of charts will illustrate the same data either better or just as well, and are easier to produce, since, in order to obtain the full effect of a circle chart, it is necessary to color the different sectors. They are not generally recommended.

A Typical Line Chart

Fig. 2 represents a typical line chart of the simplest form but, as will be noted, contains considerable data and clearly shows the relationship between the most important governing factors of an industry. This chart is a directly comparative, continuous history covering a period of five years. One can readily appreciate that without this chart a great deal of text matter would need to be included in the report to describe the trend of the factors charted, whereas by the use of the chart all that is necessary in the text is briefly to point out the important variations, the reasons for these, and to draw the conclusions therefrom.

Fig. 3 illustrates a typical line chart together with a statistical exhibit, and because of this combination it is readily understood by anyone. It also clearly indi-

cates that it is far easier and more rapid to detect the trend and the relationship of the factors from the graphic representation than from the statistical exhibit. The bar chart, at one time, was the favorite means for representing the division of factors into their component parts. However, it has been found that the line chart is more readily understandable, simpler in design, and illustrates continuity better than the bar chart.

Chart Showing Percentage Fluctuations

Fig. 4 illustrates a third type of simple line chart. The data, however, are plotted on a logarithmic scale and the chart consists of three banks of logarithms. To determine the trend of certain factors of a business it is necessary to study the per cent variations, and in order to do this the numerical data must be plotted on a logarithmic scale. These charts indicate the acceleration of increases or decreases of the various factors, and the angle of the lines with the horizontal show the comparative positions of the groups to each other. No matter what the locations on the chart, the angle of the upward or downward inclination is the same for all curves attested by the same percentage of change. The curves plotted on this type of chart not only represent percentage fluctuations, but at the same time the actual values are shown on the scale. If the quantity increases or decreases were converted to percentages, and these percentages plotted on a natural scale, the disadvantage would be that the actual values could not be shown.

Fig. 5 is a representative bar chart. This type of chart is of special use when data are charted in direct comparison with periods of time.

A typical geographical chart is illustrated by Fig. 6. This chart indicates at a glance the market situation with reference to a certain commodity not only as to dollars of sales, but also the distribution facilities through wholesale dealers. The chart illustrates a rather well-developed national distribution, and a well-distributed marketing mechanism through wholesale dealers.

Arrangement of Charts in the Report

One of the earliest practices was to keep all drawings, charts, and detailed statistical information almost entirely separate from the text matter of the report, even in some instances not binding them with the report proper. In these cases such information was considered largely as an appendix and was purely supplementary to the report. In other instances such information was grouped in the form of separate exhibits, bound in the report following the text matter, and referred to by exhibit numbers in the text. This made it necessary for the reader in every instance of reference to turn to the end of the report and study the charted data, which detracted from the reading. Not only should a report be technically correct in its data, analysis, and conclusions, but it is also very important that the entire arrangement be logical as to the sequence of the subject matter, be easily readable, and hold the interest of the reader. In order to accomplish this it is necessary to allow a great deal of latitude as to the placement of the charts in the text. The average report consists of a combination of many different arrangements, the most usual of which are:

1. Separate exhibits bound in the report following the text and referred to in the text by exhibit numbers.
2. The arrangement of the charts into groups, and a short, written analysis page added preceding each group, or as a facing sheet to each chart. Such an analysis should call attention to points of unusual significance even though such statements are a repetition of what has appeared in the text.
3. The placing of some charts in with the text, thus making them part of the reading matter of the report proper.
4. In some cases it is advisable to expand more fully upon certain phases of the business than would be proper in the body of the report. In such instances a separate exhibit is compiled, consisting of both text and charts.

The use of graphic charts for a great variety of purposes has become very popular. The majority of business men are accustomed to this form of presentation and can readily analyze the data thus presented. The method finds unusual adaptability in the field of reports, and no doubt a great proportion of the statistical data found in such reports will eventually be presented in graphic form.

A Way to Promote Satisfaction

By EVERETT W. HOWE

BIG companies lose valuable men because they are not allowed to have any choice in the work they do. If a man has worked faithfully in one department perhaps at a job where little real skill is required, he has most certainly shown that he is a valuable man to the company, and to be sure his greatest immediate value is at his old job. However, if he learns of an opportunity in some other department where he may perhaps earn more and the work may be more agreeable, he will undoubtedly use every effort to make a transfer.

Most big companies have a means of transferring which is theoretically correct, but which seldom works out to advantage in actual practice. Usually a man learns of a vacancy in some other department through a friend who is employed in that department. If he thinks he would like the job he goes to the foreman and applies for it without having consulted his own boss. If the vacancy must be filled immediately, the man will attempt to get an immediate release from his old boss. This often causes hard feelings between department heads, and the result is that the man leaves the company.

As a remedy, a definite policy should be established by which a man may better himself and also work to the advantage of the employer. One way is to publish a list of vacancies as they occur, and give all the men a chance to change. When this is done the employment office should have a man whose duty it is to confer with all the parties concerned, with the object of securing satisfaction for all.

THE EDITORS' PAGE

Proof of Control

For 600 consecutive working days, the production of the factory has exactly equaled daily the schedule of programs laid out not less than four months preceding.

COLONEL GEORGE D. BABCOCK

WE have few facts and little information as to the degree of control which can be secured and maintained in the operation of industry. We do not know, for example, whether a reasonable average of performance should be of the order of 50 to 60 per cent of what was planned, or to the order of 90 to 100 per cent. Because of this uncertainty, the first two articles in this issue are of extraordinary value and interest.

Taken together they give the broad results of an installation of scientific management in a plant building heavy machinery.

The most striking single fact is, as Colonel Babcock puts it:

"For 600 consecutive working days, the production of the factory has exactly equaled daily the schedule of programs laid out not less than four months preceding. That is, four months earlier, the requirement was laid down that certain definite items of product should be completed and shipped on a particular day. This requirement has been met without a single failure for the period stated above."

If production can be exactly controlled over 600 consecutive working days, why can it not be controlled over any period, barring calamities and acts of God beyond the power of the executives to foresee and plan for?

The Holt record tends to affirm such a possibility and tends also to place the degree of perfection production control in the high range of 90 to 100 per cent of what was planned.

But, production control is by no means all of the result. Quoting from Mr. Baker:

"In particular, scientific management has accomplished this for us; we have absolute and definite control of our shop operations; we can today determine the serial numbers of the product that will leave the assembly floor on a particular day next December, with the full assurance that these particular items of product will be delivered on that particular day and no other. We have greatly improved the quality of our product, and effected a substantial reduction in its cost. We have eliminated labor troubles and today have a body of workers that is loyal and efficient, and which will challenge comparison with other workers in the industry anywhere.

In turning to what may be looked upon as more remote factors where wise or unwise policy determination are all important, we have still a strong testimony from Mr. Baker in these words:

"It is a firm conviction that corporate control is more dependent upon scientific management so far as plant operations may be concerned, than any other one factor that enters into the financing for the corporation's requirements, sale of its product, and in fact determinations as to the desirability of setting up advertising budgets and other matters of this nature. All of these are outstanding in the conduct of the manufacturing institution as a whole, and must necessarily be predetermined under a plan of this kind. All of these eventually become a part of scientific management, to the end that the institution is controlled in a definite manner and one that can be understood by all.

In the face of such facts, concrete advantages and desirable operating results, skepticism in regard to the possibility or advantages from the exact control of operations fades away. Proof is given, that a high degree of perfection and control can be secured to the advantage of everyone engaged in or dependent upon the operation of industry.

The Pressure for Dividends

THE stockholder cuts but a small figure in the operating organization of the corporation. He is at the "bottom of the heap". His most important function is to contribute the capital that makes the corporate equine go. Thereafter he participates in corporate meetings, and hopes to participate in corporate dividends.

It is to this last possibility that the stockholders' strongest interest is directed, for dividends are the only means by which the corporate funds may be diverted to his individual advantage. They are the substance of the things he hopes for. If, then, he can squeeze dividends out of the corporate structure by means of pressure, that pressure will surely be brought to bear.

Nor are the officers and directors one whit behind the stockholders in their anxiety for dividends, for these, if adequate, are the outward and visible signs of corporate success—proof positive of the efficiency of their management—the full and unquestioned justification for their being where they are.

There is, however, a marked difference in the attitude of the stockholders and the corporate authorities toward the declaration of dividends. On the part of the stockholder there is an irresponsible and determined desire for dividends—a desire well expressed by the old song which proclaimed with such emphasis—"We must have money and we don't care how". The same strong desire for dividends exists on the part of the corporate authorities, as has been said, but this is tempered by their responsibility for the general and continuing welfare of the corporate business. An improper declaration and payment of dividends may, perchance, bring their company to disaster and themselves into public and serious condemnation. Accordingly—

save in the rare instances of fraudulent dividends—the corporate authorities are very desirous that their dividends shall be above reproach: that there shall be a free surplus from which these dividends may be properly declared, and, beyond this, free funds from which they may be properly paid—that is without a depletion of working capital that will cripple the company's activities.

And yet, in spite of this honest intent on the part of the corporate authorities, unwise and distinctly improper dividends are frequent—dividends which bring the companies into disrepute and sometimes to disaster. And such ill-judged declarations of dividends are usually due to the director's ignorance of the conditions which make them improper.

The article by Mr. Bliss, "The Protection of Working Capital," which appears on another page, addresses itself to this very point, discussing in detail the various appropriations and reserves that must be made from profits or surplus if the balance sheet is clearly to show that free surplus from which, alone, dividends may with safety be declared.

The practical value of Mr. Bliss's article is obvious. The procedure he outlines eliminates the danger of depleting working capital by improper dividends declared in ignorance of the real conditions. With both their own self-interest and the demands of stockholders pressing so insistently for dividends, the corporate authorities cannot afford to ignore measures so simple and yet so effectually safeguarding their working capital from dividend encroachment.

Peaks in Industrial Power Load Curves

IT is commonly believed among electrical engineers that there are two distinct peaks in the daily power load curves of industrial plants which do not correspond to the demands for power appropriate to the work of those plants. Realizing, that if such peaks actually exist, their elimination would tend to decrease power plant investment and the cost of power, and to lower production costs, Morris L. Cooke, Director of the Giant Power Survey for the State of Pennsylvania, requested Governor Pinchot to call a conference of representatives of interested industries and organizations to discuss the subject.

Mr. Cooke also wrote to a number of manufacturing executives and management engineers to learn if their experience substantiated the opinions of the electrical engineers and, if so, what measures they recommend for improving the present conditions.

Through the courtesy of Mr. Cooke, MANAGEMENT AND ADMINISTRATION is able to report the views expressed at the conference that was held in Harrisburg, April 8, 1924, and also to give the opinions of representative industrial executives on the subject. Since the elimination of power load peaks appears to be an important contribution in the war against waste, it is hoped that later a questionnaire concerning the causes of, and remedies for, the present unsatisfactory industrial power load curve can be presented to manufacturing concerns throughout the country. From the expressed opinions and ideas of executives interested in lowering their production costs it should be possible to formulate a definite method of attacking the problem.

Mr. Cooke stated the purpose of the conference as being an endeavor to find a way to conserve power plant and industrial plant investment and output by improving the industrial power load curve. This curve, in the opinion of electrical engineers, has two distinct peaks during the day, occurring about 9 A M and 2 P M. After these hours there is a decline in the load curve until the noon and night shutdown of machinery. In order to test the accuracy of this opinion Mr. Cooke obtained data from the Philadelphia Electric Company for various typical industries in Philadelphia, and found that they agreed with the information previously obtained. Later he obtained from Henry Ford the power load curve for Ford's Highland Park plant finding it also in agreement with the electrical engineers' opinions; and finally this belief was substantiated further by a composite curve worked out for the Pittsburgh district by Professors Rittman and Ely of the Carnegie Institute of Technology.

Mr. Gompers, President of the American Federation of Labor expressed the view that a study of the daily load curve is not sufficient, but consideration must be given the seasonal curve, the annual curve, and the business cycle curve which extends through several years.

Mr. Gadsby, Chairman of the Special Power Survey Committee, Pennsylvania Electric Association, stated that central station companies had been studying this subject for 25 years; and had been trying to bring about the very thing the conference was interested in, by considering load factor in making rate schedules and thus making it worth while in dollars and cents for manufacturers to improve their power factor. He suggested that consideration be given to the load curve to be studied. Central stations are interested in the 24 hr. load curve, but industrial executives are interested in the 8 hr. or working-day load curve.

Attention was called to the fact that daily load curve is not typical of annual load curve, and the annual load factor for any industry is much less than the daily load factor. Because of this it is necessary to decide, for the purpose of study, the basis upon which load factor is to be determined and the period over which the load curve is to be drawn.

Mr. Gadsby cited several instances where the load factor had been improved as the result of a study of its characteristics followed by proper action on the part of both the management and workers. He pointed out that different industries must use different methods to improve their load factors, but he suggested 6 subjects which he believed should be considered by each industry: determination of existing conditions, the relation of power to working conditions; the relation of power to costs; after deciding that present conditions can be improved the suggestion of ways and means for its improvement, the realization that 100 per cent load factor is unattainable, and a résumé of the entire study showing the net result in conservation of power and how it may be secured.

Mr. Noonan, President of the Electrical Workers' Union, gave his opinion that peaks in the use of power

are caused by three things: Carelessness of the workmen, neglecting to shut off machines when not needed, or using them improperly; friction caused by idleness of machine at night or during noon hour and attendant cooling of bearings and lubricant; and habit of both management and men in operating the average manufacturing plant inefficiently.

Mr. Russell, Vice-President, Philadelphia Electric Company believed that seasonal variation and the effects of business cycles have more bearing on the question than the daily load curves, inferring that improvement of the daily load curve would not result in great reduction of total power plant capacity required.

Mr. Sniffen, Manager of Westinghouse Electric and Manufacturing Company, emphasized the fact that the power companies' greatest cost is capital cost, so that the highest possible load factor is essential for their plants; and that reduction in cost of power can be brought about quicker through improving load factor than by any other way which has thus far been tried or proposed.

W. S. Murray said that capacity factor is more important than load factor, and that the fullest utilization of capacity of power plants can be accomplished through interconnection of power equipment and transmission lines.

The replies to the questionnaire sent out by Mr. Cooke form a very interesting and instructive addition to the subject discussed at the conference, and, as the writers are all actively engaged in industrial management, their thoughts and views have a strong slant of practicality. Space prevents quotation in full of all the replies, but representative extracts will be given which show the attitudes of this group of manufacturing executives.

H. S. Person, Managing Director of the Taylor Society wrote:

> The current belief of electrical engineers concerning load curves . . . checks with my understanding of the situation. . . . The solution of the problem of smoothing out the curve lies in the development of a system of management for each individual plant which is comprehensive in that it reaches back through the planning and scheduling of technical operations to market analysis, and the planning and scheduling of a predetermined balancing of sales and production which will make possible regularized utilization of the mechanical facilities including power of the plant.

In reply to further questioning by Mr. Cooke as to why, with a given demand for production in a plant during any day, the energy demand required for that production should not be spread equally over the day instead of being jammed into morning and afternoon peaks, Dr. Person wrote again:

> My empirical judgment . . . is that where such peaks occur there is absence of adequate planning, scheduling, provision of necessary materials and tools, moving materials, and so on. The absence of these things causes a delay in actual machining and power consumption for a period in the morning and early afternoon. The let-up in work in the late forenoon and afternoon . . . I believe is due in large part to the fact that without proper planning, scheduling, and tasks, individual workers do not know just how to lay out their work so as to make termination of a job coincide with the termination of the hours of labor, and to make jobs and hours of labor come out even, jobs are spread out over the latter part of the afternoon and forenoon period.

A. E. Barter, Works Manager, The Plimpton Press wrote:

> Our curve jumps in the morning when the machines are started, then drops and runs along very uniformly until just before noon, when the machines are shut off. It goes up after the noon hour after the machines are started, drops down, runs along fairly uniformly until night when it drops again. Of course there is a variation of the load due to shutting down machines if work cannot be so planned as to keep the factory busy, but we make every effort to keep the plant running continuously, and while we have not attained perfect results we have made considerable advance in that direction.

Sanford E. Thompson of the Thompson and Lichtner Company said: "With well-balanced management and spreading the work uniformly, unquestionably the demand for electric energy will be more uniform".

Walter N. Polakov wrote:

> Speaking of the individual establishments, there exists, of course, a large and neglected possibility of equalizing the load throughout the day by means of co-ordinating the functions of various departments and co-ordinating the load through a power dispatcher.

J. G. Heckman of Cheney Brothers wrote:

> Our records did show that there was a delay in building up a full load at the beginning of the working session indicating that some departments and employees were dilatory in getting to work after the starting bell. And, also, there was a very marked decrease in the load beginning about a half hour before the close of the session, indicating the shutting down of machines in anticipation of closing time.

Thomas W. Mitchell of the Federal Trade Commission wrote: "I see no reason, other than the artificial lighting load, why, if management and labor each do their part in spreading work evenly over the day, the demand for electrical energy should not be practically uniform".

L. S. Tyler, Vice-President of the Acme Wire Company, after stating that their daily load curve varied only about 5 per cent from average said: "The only suggestion I can make . . . is that the work be more carefully scheduled. . . ."

Joseph A. Carlin wrote:

> My impressions are that this is one more thing that can be laid at the door of management. If management would lead in the establishment of proper standards of performance, coupled with an incentive to maintain those standards, both production and the power load curves would be more uniform.

Hudson W. Reid offered a novel solution of the problem from the central station viewpoint when he wrote: "Primarily the cause of high load curves in the power load . . . is too much regularity. . . . Industry is overstandardized as far as the element of working hours is concerned".

NEWS OF EQUIPMENT
FOR THE MANAGEMENT

This department is conducted to give the essential facts in regard to items of industrial equipment which have recently been placed on the market, and which may be used in the operation of manufacturing concerns. As the sources of the items are reputable manufacturers, MANAGEMENT AND ADMINISTRATION accepts this information as reliable.

Reel Lifting Trailer

Index Number 658.281 Lifting trailer

THE awkward shape and great weight of reels and cable has made their handling a difficult problem, usually solved by employing gangs of 4 or 5 men with pinch bars and similar tools to maneuver the reels from place to place.

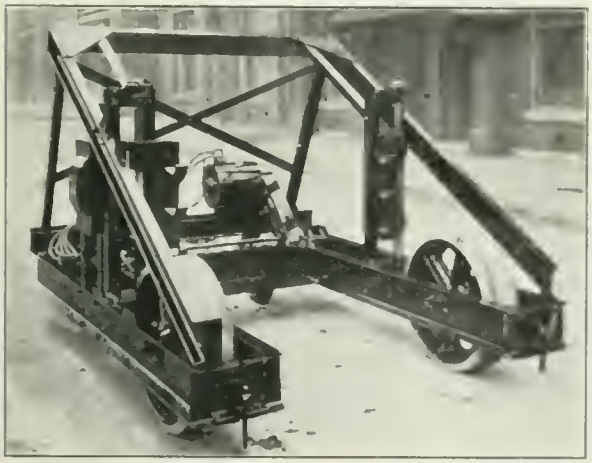

FIG. 1 REEL-LIFTING TRAILER

The Mercury Manufacturing Company has developed recently a trailer, which, in conjunction with an electric tractor permits one man to pick up, transport, or maneuver cable reels of any size and any weight up to 5 tons. This "Liftrans" trailer, as it is called, consists of a structural steel frame providing an opening into which the reel fits and a lifting device for raising and holding the reel in position.

The motive power for the lifting device is supplied by a heavy duty motor drawing its power from the storage batteries used to operate the tractor. The entire control of the reel lifting mechanism is so arranged that it can be handled by the tractor operator from the tractor seat.

A number of safety devices have been incorporated in the control arrangement. The reel can be lifted only to a predetermined height and is lowered slowly until sufficient clearance is provided to remove the shaft upon which it is supported while on the trailer. These devices prevent any operation from going beyond a point where it is designed to stop. Automatically operated brakes are provided to prevent any coasting effect. If the tractor becomes uncoupled from the trailer the plug attachments on the protected wires connecting the trailer motor with the tractor storage batteries pull out, entirely disconnecting the 2 machines.

These trailers can be built to handle any size reel and any weight up to 5 tons. Specifications for a trailer with capacity for a reel 84 in. in diameter and 42 in. wide follow: length 8 ft. 9 in.; height 5 ft. 7 in.; width 5 ft. 19 in.; turning radius, 10 ft.; lift 12 in. maximum; speed of lift, loaded 12 in. per min.; unloaded 24 in. per min.; weight 3000 lb.

Man-Cooling Fan

Index Number 621.63 Mechanical fans

FOR the relief of overheated men working in steel mills, foundries, forges, and similar places electric fans which will, at least, keep the warm air in motion are being used more and more extensively. A new man-cooling fan is being manufactured by the American Blower Company. It is built in 2 sizes: wheels 21¼ in. and 37¼ in. in diameter; operating at 1725 and 1120 r.p.m.; requiring 1 and 4 hp. respectively.

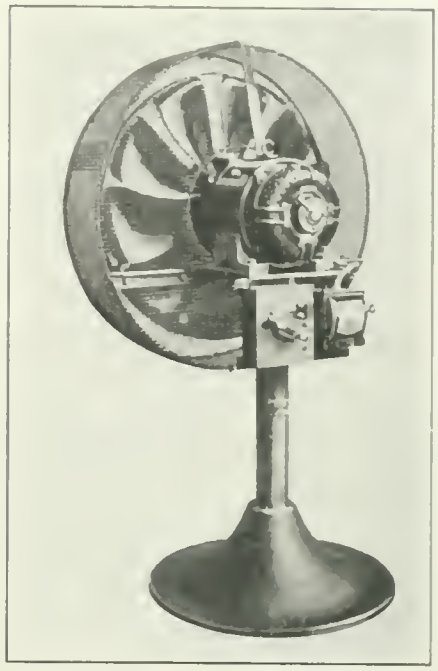

FIG. 1 MAN-COOLING FAN

Brick-Cleaning Machine

Index Number 628.28 Labor-saving devices

A DEVICE which cleans mortar from old bricks and permits their subsequent use is being manufactured by Maroa Manufacturing Company. The cutting units are made of special composition manganese and chrome white iron, and special types can be obtained which will remove concrete mortar. The

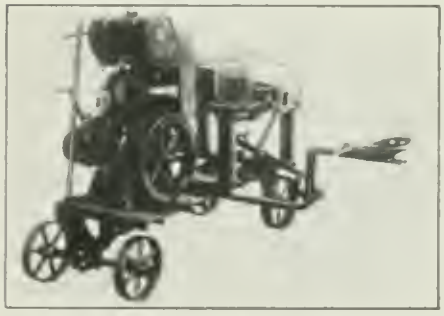

FIG. 1 BRICK CLEANING MACHINE

average cost for replacing cutters is about 10 cents a thousand bricks and the entire set can be replaced in 5 or 10 minutes.

The manufacturers claim that savings on broken bricks will often average $4 per day over hand methods, and an average saving in wages of $9 a day can be obtained if hand labor is being paid $3 a day.

The outfit is 5 ft. long, 3 ft. wide, and 3 ft. high. It weighs about 550 lb. and can be moved easily by one man. It can be furnished with or without power consisting of either water- or air-cooled engine or electric motor.

New Tip for Elecrtic Cutting

Index Number 621.93 Cutting devices

AN improvement has been made in oxy-acetylene cutting apparatus in the development of a new cutting tip by The Alexander Milburn Company.

The feature of this tip is a method of heating the gases and preheating the cutting oxygen as well as giving velocity to the jets. The mixture of the gases takes place in passages in the seat. This mixture then passes into an annular passage where it is given an additional mixing. The gases are then separated into passages leading to the tip. Here the preheated flames are projected with an increased velocity inclined toward the oxygen jet resulting in a speedier cut and narrower kerf. In cutting tests the following economies in the use of this "Super Tip" over standard tips have been obtained: Time—17.5 per cent; oxygen—10.9 per cent; acetylene—25.0 per cent.

FIG. 1 NEW TIP FOR ELECTRIC CUTTING

The tip is provided with a renewable seat which makes it unnecessary to remachine or discard used tips. This renewable seat also facilitates the cleaning and maintenance of the tip.

Watertight Service Box

Index Number 621.3117 Electric switch box

A NEW service box called the "Noark," which is a combined switch and cutout, has been developed by The Johns-Pratt Co. It is designed for use where it is advisable to provide protection against accidental contact with live metal parts and where a compact installation containing both a switch and cutout is convenient. It can be used either as a switch or cutout and also to lock off current supply to motors driving machinery which is under repair.

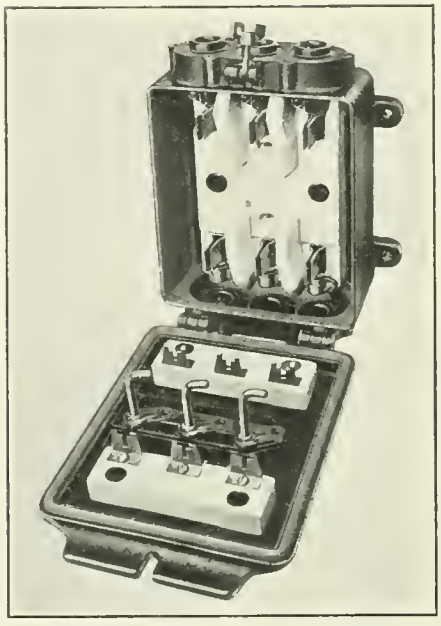

FIG. 1 WATERTIGHT SERVICE BOX

They are suitable for controlling all the light and power circuits of a factory. In such service the boxes are made up into panels. They are watertight, so can be used outdoors as well as in sheltered locations. They are approved by the National Board of Fire Underwriters both as cutouts and switches.

The enclosing case is made of heavy cast iron which is rugged and practically rust-proof. A rubber gasket is used to make the box watertight, and porcelain bushings lead the conductors into the boxes.

They can be furnished for potentials not exceeding 600 volts, and range in size from 5 x 7 x 3¾ in. to 21¼ x 26 x 9 in. and in weight from 5½ lb. to 225 lb. The ends of the boxes are planed, drilled, and tapped for the installation of conduit fittings.

Portable Elevator

Index Number 658.2812 Power hoists

AN elevator is being manufactured for moving loaded trucks, wheelbarrows, and similar equipment from one elevation to another and in places where the usual freight-elevator would not be practical. The machine may be used for portable or fixed position work. It is suitable for serving various machines and hoppers, between floors, from floor to box cars, or other places where elevating is necessary.

The equipment is self-contained and does not require extraneous support. The platform remains level under the eccentric loading of moving trucks. Electrical controls are provided to stop the movement of the platform at the upper and lower limits of its travel. The starting and stopping of the motor, the operation of the limit controls, and the movement of the platform are governed by electrical devices, eliminating mechanical fixtures.

The machine is driven by a motor through a silent chain and spur-gear drive. The load is held by a brake wheel, on the extended motor shaft,

FIG. 1 PORTABLE ELEVATOR

to which 2 brake shoes are connected by a compound lever arrangement, one end of the lever carrying the core of a solenoid brake. The application of electric current raises the core and releases the brake, permitting the platform to be elevated or lowered.

Standard capacities range from 1000 to 6000 lb. and platforms are manufactured in sizes from $3\frac{1}{2} \times 5$ ft. to 6 x 10 ft.

This equipment is manufactured by the New Jersey Foundry and Machine Company.

Dial Type Thermometer

Index Number 662.612 Thermometers

A DIAL type indicating thermometer is being manufactured by the Moto Meter Company, Inc., for use on any industrial installations requiring a recording thermometer. The use of the dial with its red pointer, black figures, and white background makes reading easy. Capillary tubing up to 25 ft. in length can be used with the thermometer permitting the dial to be placed on an instrument board considerable distance from where the temperature is to be taken.

It is simply built and contains only one bearing. The bracket is so constructed that the dial can be installed in nearly any position. The pointer is attached directly to one end of a flattened, hollow, Bourdon coil spring which, in turn, is connected by capillary tubing to a hollow copper bulb placed where the temperature is to be determined.

FIG. 1 DIAL TYPE THERMOMETER

The bulb, spring, and tubing is filled under pressure with treated alcohol that has a uniform coefficient of expansion per degree rise in temperature. When the bulb is subjected to heat or cold the alcohol expands or contracts causing the spring to wind or unwind, and so moving the pointer across the dial. A device automatically compensates for any difference in temperature in the room through which the tubing passes so that the dial reading is the true temperature at the point where the bulb is inserted.

The thermometer can be furnished for any range of temperature between 40 deg. and 650 deg. fahr. or its equivalent in centigrade. The dial weighs about 1 lb., and bulbs can be furnished, within certain temperature ranges, which can be screwed into 1 in. pipes.

New Type Induction Motors

Index Number 621.3 Induction motors

TWO new types of induction motors are being manufactured by the General Electric Company. The SCR single-phase motors are designed for constant speed at 40, 50, or 60 cycles, are furnished in sizes from $\frac{1}{2}$ to 10 hp., and are interchangeable for 110 or 220 volt circuits. The KT-900 type is a riveted frame, polyphase, induction motor, of three- and two-phase squirrel cage, 60-cycle design, and is being built in sizes ranging from $\frac{1}{2}$ to 15 hp.

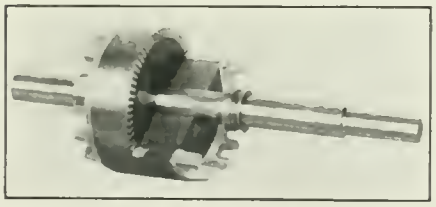

FIG. 1 ROTOR FOR KT-900 MOTOR

The new single-phase motor, operating on the squirrel cage induction principle, eliminates the short-circuiting switches heretofore considered essential. It combines high starting torque with low current demand, the maximum and accelerating torques being about 200 per cent of full load torque without any low points during acceleration. The no load and full load speeds are, respectively, about 3 per cent above and below synchronous speed.

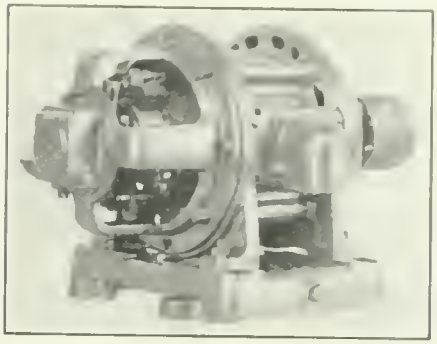

FIG. 2 TYPE SCR MOTOR WITH BASE

The electrical improvements embodied in the new polyphase motor comprise reduced heating, higher efficiency and power factor at full and fractional loads, and increased starting torque. The maximum torque ranges from 275 to 300 per cent of full load synchronous torque and the accelerating torque curves are free from dips. The principle mechanical improvements include an increase in oil reservoir capacity, a new method of ventilating to prevent dirt from settling on the windings, and a cast motor of one-piece construction having no joints nor high resistance spots.

Reflector for Concentrated Light

Index Number 658.242 Lighting devices

FOR use in any industrial operation where a highly concentrated light is desired over a limited area, a new reflector has been developed recently by Westinghouse Electric and Manufacturing Company. This reflector has been designed to give

FIG. 1 REFLECTOR FOR CONCENTRATED LIGHT

a large light distribution from a 25 or 50 watt mill type lamp, and provide a high intensity of illumination over the working area. It is particularly suitable in such work as machine sewing, coil winding, and other operations requiring accurate vision.

The body of the reflector is a one-piece steel stamping to which is applied a ground coat of fired porcelain enamel and then a finishing coat of enamel, green on the outside and white on the inside. The reflector is provided with a brass holder so that it may be fastened on a brass shell socket without other support.

Drum Hoist Limit Switch

Index Number 621.3117 Electric switch

A LIMIT switch developed by the Roberts and Schaeffer Company for use on their own automatic electric hoisting equipment is being offered for use on other types of equipment.

This switch is designed as a precautionary measure only and will prevent overwinding of any electrically driven hoist if all other control apparatus fails. It is a form of insurance, and though it may seldom come into operation, when its use is needed it will prevent overwinding and possible wrecking of the hoisting equipment.

Its operation is simple. It is wired between the terminals on the electric control board, and should the drum overtravel, a spring switch automatically functions, breaking the current and setting a solenoid brake. To install the switch it is only necessary to tap a 5/16 in. hole for the drive pin in the end of the hoist drum shaft.

The switch is applicable for hoists having a maximum average travel of 128 ft., vertical lift, using a 36 in. drum.

FIG. 1 DRUM HOIST LIMIT SWITCH

Leakproof Sleeve Bearing

Index Number 621.82 Sleeve bearing

A NEW type of sleeve bearing for electric motors, designed to prevent the leakage of oil into the windings, or the entrance of dust into the bearings, has been developed by the Westinghouse Electric & Mfg. Co.

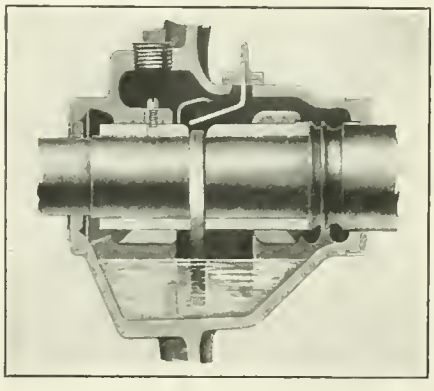

FIG. 1 LEAKPROOF SLEEVE BEARING

A connecting passage in the upper part of the bearing housings secures a condition of balanced air-pressure in the separate chambers into which the housing is divided by the bearing supports. The action of the blower at high speeds sets up a vacuum next to the inside of the housing and, since it is impossible to seal the housing at that point because of the shaft passing through, the vacuum is communicated to the space within the housing itself.

For inspection of the oil ring, a large air-tight, threaded pipe plug is provided. Where the shaft passes through the bearing a method of supporting the felt dust-proofing washer is used in which the mental cap has a diameter at least 1/4 in. larger than the shaft, thus lending resilience to the felt.

By preventing oil leakage the Sealed-Sleeve bearing eliminates weakening of the motor insulation by the lubricant and the resulting short circuits and grounds. Oiling once or twice a year is practically the only attention the bearing requires.

AutomaticTime Recorder

Index Number 621.52 Time clocks

THE Stromberg Electric Co. is manufacturing an electric in-and-out time-recorder which is fully automatic in operation. It requires no winding, oiling, or regulation.

The recorder has automatic day-to-day card lift, in-and-out shift, 2-color ribbon mechanism to show irregular time, and ribbon reverse. A. M. time is printed in straight light-faced type and P. M. time in italic heavy-faced type. An improved card abutment insures each record being printed in the correct space, and a protective type guard is employed so that all imprints are always clear and do not show top or bottom of other imprints.

Recorders can be furnished to show, in connection with the time registration, either an abbreviation of the day of the week or the date of the month. These machines print on the face of the card.

FIG. 1 AUTOMATIC TIME RECORDER

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 150 magazines; it also includes the publications of some 50 book publishers and professional societies as far as these are of managerial interest to industrial executives. The items are prepared and classified by the Engineering Societies Library in New York City. The decimal number at the right of each item is the index number and indicates the place the article or book will take when filed in accordance therewith in the classified subject scheme. If articles are grouped according to these numbers like subjects will automatically fall together and related subjects will follow in logical sequence. Photostat copies of any magazine article indexed can be supplied by The Ronald Press Company for a moderate charge. The books and pamphlets indexed can be procured from their respective publishers.

Accounting

Analysis of a Customer's Account. 657:332.1
James H. Kennedy. *American Bankers' Association Journal*, April 1924, v. 17, pp. 644-645, 687. This analysis is made for the purpose of determining the value to the bank of each customer's account. Cost accounting as applied to banking.

Cost Accounts. 657.452
By G. H. Newlove. 179 pp. The White Press Co. Washington, D. C. $2.50. This book is a textbook for cost accounting students and deals particularly with the "how" of cost accounting rather than with the needs and applications of costing. There is very little theory, but the actual operation of a cost system is described in detail with numerous illustrative charts and forms. In the appendix is given a number of practical problems and the publishers will furnish bound, specially-ruled books for use in solving them. Teachers and N. A. C. A. members can also obtain complete solutions of the problems from the publisher.

Cost Control for Knit Underwear Factories. 657.677
Published under the auspices of The Associated Knit Underwear Manufacturers of America. 259 pages. The Ronald Press Company, New York. $5.00. This work was prepared for the purpose of enabling the association to furnish to members a comprehensive and dependable guide to the best cost and statistical methods. It is the result of a five-year survey, conducted at a total cost of $175,000, involving as it did the services of 22 account ants and first-hand studies in 96 mills. It presents simple working methods, with 105 forms, covering every phase of cost accounting in a typical knitting mill. It is a volume of much suggestive value to those in other industries with similar problems.

Cost Finding in Knitting Mills. 657:677
By Stephen R. Gordan. 204 pp. Bragdon Lord and Nagle Co., New York. $4.50. There have been many books written on the general principles of cost accounting but the application of these principles to a particular problem or even to a particular industry has been left to the reader. The present work was written with the belief that an executive should be able to obtain a treatise covering the application of general costing principles to his particular industry written by a specialist in that line. It contains an outline of methods developed and installed in many representative knitting mills throughout the country and should be very valuable to executives in that business. The entire procedure necessary to control shop work and determine costs is described in considerable detail with a large number of charts and diagrams.

Cost Records of 1923. 657.452
R. H. Lauberscheimer. *Fibre Containers*, March 1924, pp. 38-39. Five estimating tables compiled from costs accumulated and averaged during 1923 at the Corrugated Paper Products Co.

Describes Foundry Cost Plan. 657:621.72
Thomas Perkins. *The Foundry*, April 15, 1924, v. 52, pp. 303-306. Methods of obtaining accurate cost figures in the various steps in producing castings, in order to eliminate the evil of flat rate per pound.

Finding and Making Use of Factory Costs. 657.452
A. W. Rowley. *Industrial Management* (N. Y.), April 1924, v. 67, pp. 195-200. Charts. Detailed description of how accurate cost figures are arrived at with a minimum of extra labor. Eleven graphic charts illustrate the text.

First Steps in Cost Accounting in Trade Associations. 657.452
T. J. Burke. *Paper Trade Journal*, April 10, 1924, v. 78, pp. 309, 313. Suggestions by the Secretary of the Cost Association of the Paper Industry as to how the Cost committee can arouse interest and "sell" to the industry the idea of installing correct cost methods.

Goldmarkpreise und Selbstkostenverminderung. 657.452
Schulz-Mehrin. *Maschinenbau*, February 28, 1924, v. 3, pp. 324-327. Problem of industrial cost accounting in Germany at the present time as compared with 1914.

A Jobbing Shop Cost System. 657.452
Machinery, April 1924, v. 30, pp. 595-596. Illus. Cost system used by the Urbana Tool and Die Co. Two forms are used in the shop, while loose leaf books in the office give complete information of each job.

Relation of Depreciation to Costs. 657.42
M. J. Smith. *Canadian Manufacturer*, March 1924, v. 44, pp. 32, 34. Outlines briefly seven methods of allowing for depreciation.

Advertising

Advertising Arts and Crafts 659.1(058)
Jan. 1924. Semi-Annual, 353 pp. Lee & Kirby, Inc., New York. $1.50. For the purchaser of art work for advertising or other purposes this book will provide a valuable list of sources of supply. The text matter consists of classified lists of artists, engravers, lithographers, photographers, and similar callings, and gives the address and telephone numbers of all. More than half the book is devoted to advertising matter where the prospective purchaser can find samples of the work done by a great number of the individuals and firms listed and thus can more easily determine which is best able to serve him.

Crystallizing Public Opinion. 659.13
By Edward L. Bernays. 218 pp. Boni and Liveright, New York. $2.50. The term "public relations counsel" is a new one to most people but it is being used to describe the profession formerly known as "press agents". To many the latter term brings up thoughts of circuses, theaters, and similar institutions, but Mr. Bernays convinces the reader of his interesting book that the public relations counsel has a very real and useful field for work. The counsel's task lies in knowing what constitutes public opinion and how to modify it to serve his particular purpose. The author illustrates how the problem is solved by citing a large number of actual cases wherein public opinion has been swayed for some special purpose. To the manufacturer desirous of a broader distribution for his product, or to one who wonders why the public does not demand his wares, this book will present some new ideas.

Nine Ways to Get Buyers to Use Product Correctly. 659.1
John Allen Murphy. *Printers' Ink Monthly*, April 10, 1924, v. 127, pp. 3-6, 164. Gives methods in use by several companies for teaching the buyer how to use the article he buys. Shows value of instructional advertising.

The Relation of Advertising to Capital Turnover. 659.1
J. K. Mason. *Printers' Ink Monthly*, April, 1924, v. 8, pp. 69-70, 112. Ultimate object of advertising is full utilization of plant capacity. It can put pressure on a slow line and increase a popular line, help simplification and create a demand for greater production.

Werbung durch Karteiblätter. 659.1
G. Unger. *Maschinenbau*, February 28, 1924, v. 3, pp. 328-329. Suggests to manufacturers an advertising form card that will be more permanent than the page or leaflet sent to subscribers in the trade magazines. A card of uniform size, giving only essential information can be kept and filed. Many such would build a valuable index and be more up to date than directories.

Werbungspsychologie auf Ausstellungen. 659.1
T. König. *Maschinenbau*, February 28, 1924, v. 3, pp. 327-328. Value of psychology in advertising.

When a Whole Industry Advertises. 659.1
Ruel McDaniel. *The Nation's Business*, May 1924, v. 12, pp. 31-33. Practical illustrations to show that co-operative advertising pays.

Building and Equipment

Building Programs and the Business Cycle. 658.1
T. S. Holden. *Buildings*, April 1924, v. 61, pp. 903-907. Careful observance of the cyclical trend, discounting the seasonal trend, and knowledge of surrounding conditions, as an aid in judging the best time to build. Charts.

The Choice of an Industrial Building Site. 658.21
M. M. Osborne. *Buildings*, April 1924, v. 61, pp. 881-883. (From Architectural Forum). Factors entering into the selection of the locality and the actual site. How the engineer and architect can be of assistance.

Modern Maintenance of Plant and Equipment. 7. Making the Most of Artificial Light. 658.242
W. G. Ziegler. *Industrial Management* (N. Y.), May 1924, v. 67, pp. 287-293. Methods of lighting; factors entering into an efficient system which increases production and reduces accidents.

The New Competition and Your Building. 4. Daylight and Modern Building Construction. 658.24
W. F. Ballinger. *Industrial Management* (N. Y.), April 1924, v. 67, pp. 250-254. Illus. Considers ratio of window area to floor space, use of sawtooth construction, improved types of glass, and surfacing walls and ceilings.

The New Competition and Your Building. 5. Roofs for Industrial Buildings. 658.23
W. F. Ballinger. *Industrial Management* (N. Y.), May 1924, v. 67, pp. 297-302. Illus. Advantages of the "A" type, the Howe truss, and the sawtooth type of roof. Various surface materials and their application.

Economics

Adjusting Immigrant and Industry. 325
By William M. Leiserson. 348 pp. Harper Brothers, New York. $2.50. This volume is the result of a study in methods of Americanization prepared with the assistance of the Carnegie Corporation. It contains a comprehensive treatment of the problems which confront American business men in adjusting foreign-born laborers to the demands of industry. Following the statement of the problems considerable space is given to solutions which have been tried throughout the country, in different types of industry. A large number of concerns have given much thought to their immigrant labor and have adopted various plans to make it more effective. Résumés of these plans are given with some idea of their success. It is a very interesting book and will be valuable, as well, to anyone who employs foreign-born labor.

America's Industrial Production Methods. 338
J. H. Barnes. *American Economic Review*—Supplement, March 1924, v. 14, pp. 109-116. Analysis of the home market and how it is maintained, taking up inventions, devices for handling enlarged production, and the employment of the labor released by these inventions.

Export Markets Offer Opportunities to Tool Builders. 382
W. H. Rastall. *Iron Trade Review*, April 3, 1924, v. 74, pp. 921-922. Greatest chance lies in field formerly dominated by German machinery exporters, and in countries now undergoing natural expansion, as Japan, Central Europe, etc.

Foreign Trade in Relation to Industry. 382
F. C. Mills. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 573-576. The law of comparative costs, the balance of trade, pre-war trade relations of the U. S., trade relations during the war, changes in the exports and imports of the U. S. To be continued in the June issue.

Fundamentals of Public Utility Power Rates. 650.6(0023)
Egbert Douglas. *National Engineer*, April 1924, v. 28, pp. 151-155. Explanation of the different charges in public utility power rates. How to figure current charges to arrive at the amount paid per kilowatt-hour. Private plant often has the advantage both in load factor and cost of installation.

Nachrichtendienst fur den deutschen Aussenhandel. 382
F. Runkel. *Maschinenbau*, February 28, 1924, v. 3, pp. 330-331. Germany's problem of re-establishing her export trade. How can the manufacturer best keep in touch with international commercial questions, and what is the best way of disseminating such information.

National Association of Railroad and Utilities Commissioners. Proceedings of the Thirty-fifth Annual Convention, Miami, Fla., 1923. 650.6
469 pages. The Ronald Press Company, New York, $5.00. The National Association of Railroad and Utilities Commissioners was organized for the promotion of public interests and the discussion of matters connected with the regulation of railroad, trolley, gas and electric light and power, and other public utility corporations. It also promotes uniform regulations where such corporations operate in more than one state, and works for co-operation between state commissions and the Interstate Commerce Commission. The subjects brought up at the convention held last December and fully presented in this report include super-power, public ownership and regulation, grade crossings, motor vehicle transportation, and proposed amendments to the Transportation Act of 1920.

Points of Law for Business Men. 347
R. K. Logan. *The Canadian Manufacturer*, April 1924, v. 44, pp. 27-28. Covers leases, sales questions, contracts, libelous letters, etc.

Shifting of Occupations Among Wage Earners as Determined by Occupational History of Industrial Policyholders. 331(001)
Louis I. Dublin and Robert J. Vane. *Monthly Labor Review*, April 1924, v. 18, pp. 34-42. Statistics compiled from the records of the Metropolitan Life Insurance Co., taken at the time of the issuance of the policy and at the death of the policyholders.

The Socialization of Industries. 338
L. Kotany. *American Economic Review*—Supplement, March 1924, v. 14, pp. 127-139. Contends that industries differ widely in operating ratios and while they may be divided into two classes, only one of these classes may be socialized to advantage.

Some Fundamental Concepts of Statistics. 31
W. M. Persons. *Journal of American Statistical Association*, March 1924, v. 19, pp. 1-8. Purpose is "to consider the nature of the argument which proceeds from an examination of series of economic statistics."

The Southward Trend of Manufacturing. 338(75)
R. G. Macy. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 517-522. This first section covers the Piedmont section of the Carolinas. A map gives the location of industrial plants and the text describes the water supply, labor supply, and transportation facilities of the district.

Taxation: the People's Business. 336.24
By Andrew W. Mellon. 227 pp. The Macmillan Co., New York, $1.25. The question of taxation has been receiving particular attention throughout the country during the past months, and the controversy has centered around the so-called "Mellon

plan'' of taxation. Hundreds of thousands of words have been spoken and written both for and against this plan until the average business man is liable to forget the real issues. In order that the layman may thoroughly understand the position taken by the Treasury Department Mr. Mellon has written this statement in nontechnical terms, of the principles and policies upon which the ''Mellon plan'' is based and of what results are expected from its operation. It is a very clear exposition of a subject which is usually quite unintelligible to anyone but an expert. Whether the reader of the book agrees with Mr. Mellon or not he is sure to gain a much clearer understanding of the difficulties accompanying the formulation of any taxation program, and he will be in a better position to judge the relative merits of the various plans now under discussion.

Education

Can a School Turn Out First-Class Machinists? 6(07)
C. O. Herb. *Machinery*, April 1924, v. 30, pp. 622-625. Illus. Methods followed in a trade school machine shop that is run on a commercial basis.

Das Dampfkesselwesen und die Technischen Hochschulen. 6(07)
F. Döhne. *Zeitschrift des Vereines Deutscher Ingenieure*, March 29, 1924, v. 68, pp. 310-312. Ways and means for enabling German technical colleges to give more consideration to boiler technique in their curriculum and research departments.

French Establish Foundry School. 6(07)
V. Delport. *Iron Trade Review*, April 10, 1924, v. 74, pp. 992-994. Illus. Comprehensive plan to provide thorough preparation for foundry engineers and managers. School is linked with apprenticeship system.

Has Psychology a Place in Modern Business? 658.386
S. S. Rowntree, Jr. *Business Organization and Management*, April 1924, v. 10, p. 25. Stresses the value of training of employees. Half of the article is devoted to motion-study.

Training Program for the Factory Foreman. 658.386
J. K. Novins. *Open Shop Review*, April 1924, v. 21, pp. 156-160. Difficulty of the problem and the qualifications of the instructor. Of interest to executives, and to the man who hopes to improve his position.

Über Technikererziehung. 6(07)
J. Schenk. *Zeitschrift des Vereins Deutscher Ingenieure*, March 29, 1924, v. 68, pp. 313-315. Address delivered before the Breslau technical college on ideals and standards in technical training.

Fuel

Bituminous Coal in Large Water-Gas Generators. 662.6
W. J. Murdock. *Gas Age-Record*, April 26, 1924, v. 53, pp. 555-561. Illus. Problems encountered in changing from coke to soft coal as a generator fuel. Sums up result of experience in five brief statements.

Bituminous Coal Trade and Prosperity. 662.65
Black Diamond, March 15, 1924, pp. 295-296; March 29, 1924, pp. 377-378; April 12, 1924, pp. 436-437; April 19, 1924, pp. 467-468. A series of articles in which government experts make exhaustive study of industry and its relation to business in general—statistics and conclusions concerning cost, price and profits. Charts and tables.

Economic Phases of Coal Storage. 662.65
F. G. Tryon and W. F. McKenney. *Universal Engineer*, April 1924, v. 39, pp. 19-25. Charts. The practice of storage and its value from the viewpoint of the periodic fluctuations in price and supply.

Generation of Power with Factory Refuse. 662.6:628.54
F. Johnstone-Taylor. *Power Plant Engineering*, March 15, 1924, v. 28, pp. 326-328. Waste wood and other combustible refuse—cocoanut shells, rice husks, mealie cobs, and sugar cane refuse—as a source of power, either by burning under boilers or by gasifying for use in gas engines.

Miner's Wages and the Cost of Coal. 662.65
By Isador Lubin. 313 pp. McGraw-Hill Book Company, Inc. New York. $2.50. Nearly every year American manufacturers are presented with some new fuel problem. Since 1919 bituminous coal prices have fluctuated widely—from $2 to $10 per ton; 2 strikes have made it almost impossible to obtain fuel at any price; and new price fluctuations and threats of strikes or shutdowns are constantly occurring. The miners and operators have each held the other responsible for the prevailing disorder and the question of wages has been prominent in all their controversies. This book, prepared under the direction of the Institute of Economics, gives an unbiased review of the relations between wages and the cost of coal; shows how the present condition is a natural result of the system of wage-payment in vogue; and offers some valuable suggestions for a more stabilized industry. To anyone who has suffered because of the periodic strikes and the wide fluctuations the information contained in this book will be enlightening.

Powdered Coal in the Paper Industry. 662.65
A. J. T. Taylor. *Paper Trade Journal*, April 10, 1924, v. 78, pp. 118-122. Possibilities of pulverized fuel in producing cheap steam, essentials of a good system, savings made possible by its use in the paper industry boiler plant.

Power Plant Management. 662.75
Robert June. *The Blast Furnace and Steel Plant*, April 1924, v. 12, pp. 210-213. Fifth of a series of articles. Advantages and disadvantages of fuel oil and factors in its efficient use.

The Sizing of Small Coal. 662.65
Thomas Fraser. *Coal Industry*, March 1924, v. 7, pp. 121-124. Second article on methods of screening and sizing for dry cleaning of coal and coke. Includes tables of capacity tests on the electric vibrating screen.

The Storage of Bituminous Coal. 662.65
W. Seymour. *The Engineering Journal*, April 1924, v. 7, pp. 183-185. Charts. Losses that may occur in storage coal and proposed remedies. Recommends screening the coal at the point of storage and stocking the lump and screenings separately.

Management

Budgetary Control. 658.14
W. Carswell. N. Y., 1924. National Association of Cost Accountants. *Official Publications*, v. 5, no. 16, 17 pp. Considers the preparation of the budget and its advantages and gives sample budget reports.

Captains of Industry vs. Captains of Finance. 658
Edward A. Filene. *Harper's Magazine*, March 1924, v. 148, pp. 481-486. The author believes that the tendency of finance to control administrative policies in modern industry is harmful to the best business development. He shows how it furthers social discontent and plays into the hands of those exploiting this discontent.

A Decade's Development in Management. 658
Henry P. Kendall. *Bulletin of the Taylor Society*, April 1924, v. 9, pp. 55-65. The new production capacity has put added pressure on the production organization for economies; on the sales organization for greater volume; on the finance, accounting, and controlling organizations for exact knowledge of internal and external conditions.

Factory Management. 658
By Henry Post Dutton. 324 pp. The Macmillan Co. New York. $2.75. In this volume is presented a general view of factory organization and management. All phases of management from financing to wage-payment are covered to some extent. It is obvious, however, that when the author attempts to elucidate a subject such as accounting, for example, about which volumes and even libraries have been published, he can generalize only and present few new thoughts of practical value in a single chapter of 15 or 20 pages. The book is well written and, as far as it goes, handles the subject satisfactorily.

Industriebetriebslehre. 658
By E. Heidebroek. Julius Springer. Berlin, Germany. 285 pp., illus., charts, $4.20. A thoughtful discussion of the main problems of industrial management, costing, factory organization, wages, depreciation and maintenance, with examples of cost systems for power plants and machine works. The book is not intended for beginners but for manufacturers and managers of experience who wish a connected elucidation of the broad principles of efficient management.

Is Management a Profession? 658
W. E. Wickenden. N. Y., American Management Association, 1924. (Special papers, series, no. 3). 2 pp. Distinguish-

ing characteristic of professional activity. Author believes there is being developed a profession of management—professional not only in technical expertness, but also in codes of honor and accountability.

Management as an Executive Function. 658
John H. Williams. *Bulletin of Taylor Society*, April 1924, v. 9, pp. 66-71. Emphasizes modern biology and psychology as essential to the development of a science of management.

The Mechanical Engineering of Management in the Metal-Working Trades. 658
Robert T. Kent. *Mechanical Engineering*, May 1924, v. 46, pp. 272-273, 307. Practical requirements necessary before the principles of scientific management can be applied effectively.

A Method of Expense Control that Paid. 658.14
M. R. Lott. *Industrial Management*. (N. Y.), May 1924, v. 67, pp. 284-286. System used by the Sperry Gyroscope Company to aid in estimating and controlling costs of making additions, replacements, and rearrangements in the plant.

A New Type of Tabulating Machine. 651.264
The Engineer, March 14, 1924, v. 137, pp. 274-276. Illus. Hollerith tabulating system and its operation.

Organized Business Knowledge. 658
By Joseph French Johnson. 204 pp. B. C. Forbes Publishing Co., New York. $2.00. Dean Johnson says in the preface that this book is not intended to give a digest of what organized business training includes but rather to sketch a picture of what present-day management problems involve. The book contains what might be called thumbnail sketches of business problems. Organization, finance, management, marketing, accounting, etc., are each given a few pages. No new ideas are presented and none of the subject matter is developed sufficiently to be of value to the executive.

Organizing a Great Industrial: Tuning-up General Motors—V. 658.16
C. S. Mott. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 523-527. A description of the system of organization and administration of this automobile firm. An organization chart is included.

Die Rationalisierung Im Deutschen Werkzeugmaschinenbau. 658
By Fritz Wegeleben. Berlin, Julius Springer, 1924. 172 pp., 10x6 in., paper. $1.45. This work is a presentation of "American" methods of organization and management, illustrated by the practice of the Ludwig Loewe Company, the first firm to adopt them in Germany. The book discusses the trend of development in industrial organization, standardization, specialization, methods of increasing productivity, personnel management, welfare work, wage systems, etc. The author writes from long experience as a factory manager and as a student of economics; he attempts to select essentials from the great diversity of problems connected with the rationalizing of industry and to present these with an appreciation of their economic significance. Literaturverzeichnis, pp. 169-172.

Surplus and its Constructive Application. 658.14
J. H. Bliss. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 529-532. How to analyze the Surplus account of a business and determine the elements of free surplus.

What Kinds of Catalogues Are Kept for Reference. 651.6
George A. Chapman. *Printers' Ink Monthly*, April 1924, v. 8, pp. 62, 65-66. Illus. Devices that will help to give permanency to trade catalogs. Two filing folders are described.

Management of Special Industries

Commercial and Research Department Feature. 658.9:656.2
Pittsburgh Organization. *Electric Railway Journal*, April 19, 1924, v. 63, pp. 620-623. Illus. Pittsburgh Railways Sales Department was organized with executive powers to cover fares, service, and relations with the patrons. Research Department will be source of data for all other departments.

Conveyors Require Good Management. 658.9:677
R. T. Kent. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 539-543. Shows how a by-product, wholly unlooked for, resulted from the use of the mechanical conveyor in the cotton mill. This by-product caused the adoption of the principles of good management.

Handling Production Problems. 658.9:677
Henry O. Lowell. *Textile World*, March 22, 1924, v. 65, p. 41. Study and construction which must precede installation and detailed operations are given first, followed by a detailed account of the weekly routine of the planned control of production.

Keeps Tabs on Cleaning Costs. 658.9:621.72
B. K. Price. *The Foundry*, April 1, 1924, v. 52, pp. 272-274. Illus. Steel foundry pays grinder hands according to the amount of metal removed. Castings weighed before being delivered to the grinder and after being ground.

The Operation of a Brass Foundry Under Scientific Control. 658.9:621.72
F. W. Rowe. *Foundry Trade Journal*, April 10, 1924, v. 29, pp. 291-296. Management methods and charts.

Power Organization in the Steel Industry. 658.9:669.1
Bryant Bannister and F. M. Van Deventer. *Mechanical Engineering*, May 1924, v. 46, pp. 248-250. Compares power requirements of steel works with central stations. The fundamental problem is not one of technical engineering alone, but of organization. Considers also consolidating the power interests of a corporation comprising several companies.

Material Control

The Control of Materials. 658.78
P. M. Atkins. *Industrial Management* (N. Y.), May 1924, v. 67, pp. 310-318. How to determine what material, and how much, and when it is wanted; also provision for its receipt and storage; essentials of an efficient working mechanism.

Extreme Variety Versus Standardization. 6. Warehousing and Shipping Electrical Products. 658.78
J. M. Van Deventer. *Industrial Management* (N. Y.), May 1924, v. 67, pp. 303-308. Illus. Shipping at the General Electric Company at Schenectady. Routine of filling orders, packing, and loading according to type of material and conditions to be met at destination.

Handling Distribution by Zones. 658.784
G. A. Nichols. *Printers' Ink*, April 24, 1924, v. 127, pp. 3-4, 6. How leading manufacturers fill vital merchandising needs by warehousing reserve stock at strategic points.

Obtaining Equipment and Supplies for Maintenance. 658.78
J. E. Housley. *Industrial Engineer*, April 1924, v. 82, pp. 169-173. Illus. Charts. Process followed, together with methods of storing and accounting for the material from the time it is received until it is used.

One Master Form Basis of Material Buying and Control System. 658.78
W. L. Carver. *Automative Industries*, April 10, 1924, v. 50, pp. 806-811. Illus. Chandler Motor Car Company has simplified scheme. Eliminates bookkeeping from purchasing, stock, and production departments.

The Railways Material Investment. 658.78
C. L. Thompson. *Railway Review*, April 26, 1924, v. 74, pp. 757-759. Stores and material control methods used by the Canadian National Railways.

Mechanical Handling

Automatic Coke Hoist. 658.281:662.74
D. C. Cross. *The Gas World* (England), March 29, 1924, v. 80, pp. 292-293. Apparatus designed for use in the water-gas plant at the Lea Bridge gasworks. Works in a vertical position alongside the telpher track.

Coke-Handling Plant at Portsmouth Gas Works. 658.281:662.74
S. E. Whitehead. *The Gas World* (England) March 22, 1924, v. 80, pp. 264-271. Illus. Description and comparison of costs of three systems of handling hot coke discharged from beds of horizontal retorts. Touches on quenching, storage, and telpher handling.

Controlling the Flow of Package Products by Materials Handling Equipment. 658.281
Jerome Mendleson. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 545-550. Illus. A comprehensive article on routing and material handling as worked out by the B. T. Babbitt Company in the manufacture of chlorinated lime, caustic soda, cleanser, and powdered, granular and solid lye. Gives charts of route lines.

Conveyors Require Good Management. 658.281:677
R. T. Kent. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 539-543. See Management of Special Industries.

Cutting Corners in Material Handling. 658.281
A. G. J. Rapp. *The Blast Furnace and Steel Plant*, April 1924, v. 12, pp. 12-16. Illus. Instances where horizontal conveyors, locomotive cranes, etc., resulted in economy of space, time and labor.

How Lift Trucks Aid in Safe Handling of Material. 658.281
A. L. Lewis. *National Safety News*, April 1924, v. 9, pp. 21-22. Illus. The lift-truck and the stacker or tiering machine as mechanical devices for handling material from the viewpoint of both safety and efficiency.

Increasing Production by Power Conveyors. 658.2812
C. O. Herb. *Machinery*. May 1924, pp. 706-709. Japanning and assembly conveyors, and conveyors for cleaning work before nickel-plating.

Industrial Cranes and Their Varied Uses. 658.281
M. W. Potts. *Industrial Management* (N. Y.), April 1924, v. 67, pp. 216-223. Illus. Types discussed are the skeleton platform cranes, jib, derricks, or pillar cranes, pillar jib, overhead traveling, Gantry, locomotive cranes, and their drive and load handling attachments.

Is Materials Handling Emulating the Automobile Industry? 658.281
M. W. Potts. *Industrial Management* (N. Y.), May 1924, v. 67, pp. 265-271. Various developments of materials handling equipment reveals the need for co-ordination of manufacturers and the building up of a sales plan.

Materials Handling Methods that Have Added to Industrial Profits. 658.281(002)
G. E. Hagemann. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 557-562. The data compiled show actual savings in costs and labor that have been obtained in a wide variety of industries using the larger types of equipment. Includes valuable cost tables.

Measuring the Savings of Mechanical Handling. 658.281
W. T. Spivey. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 551-556. Illus. Factors in the selection of equipment for an installation.

Mechanical Coal Loading. 658.281:622
R. A. Walter. *Coal Mine Management*, April 1924, v. 3, pp. 50-54. Limited to the handling of coal in the mine, where every mining factor must be ascertained and analyzed before the equipment is installed.

Quality Production from the Application of Automatic Handling Equipment. 658.281:664.1
C. J. Alfred. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 563-566. Illus. Methods used in the packing departments of one of the plants of the American Sugar Refining Company. How Domino package sugar is handled to assure profitable operation.

Shop Transportation Economics, Westinghouse Methods and Results. 658.281
S. M. Lowry. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 533-538. Illus. Description of handling work which falls into four divisions: broad-gage railroad; narrow gage or industrial railway; electric battery industrial trucks; and automobile road trucks. An organization chart of transportation activities is included.

Personnel

Business Cycles and Unemployment. 658.3
Willard E. Hotchkiss. *Taylor Society Bulletin*, April 1924, v. 9, pp. 86-89. A recent study of the cycle and of measures taken by various firms to avoid its influence. Includes an investigation made under the auspices of the National Bureau of Economic Research.

Community and Personnel Problems. 658.3
Report of the Committee on Community Co-operation, of the American Management Association. Chairman, J. F. Ahlers. N. Y., 1924. (Committee report series, No. 11). 6 pp. Need for industry to take an active interest in civic problems.

Finding Jobs for the Ex-Soldiers. 658.311359
Dr. Frank V. Quillin. *American Industries*, April 1924. v. 24, pp. 5-10. Outlines the work of the Veterans' Bureau. Asks for the co-operation of manufacturers and business men in placing rehabilitated soldiers in industry.

Following Up Foreman Training. 658.31243
John Calder. American Management Association, 1924. 12 pp. Address at convention of American Management Association, 1923, followed by discussion.

Housing Employees. 658.3833
M. R. Lott. N. Y., American Management Association, 1924. (Convention address series, no. 91. 9 pp. Results of an investigation of the housing situation in various centers throughout the United States. Recommends that industry take the initiative in improving conditions where necessary.

The Human Factor in Management. 658.3
Gordon A. Johans. *Business Organization and Management*, April 1924, v. 10, p. 48. Last article in series which points out weaknesses of modern wage systems and suggests other methods of satisfying both labor and capital.

Labour Turnover and How to Reduce It. 658.3126
F. Whitman. *Business Organization and Management*, April 1924, v. 10, pp. 39-42. How to calculate and reduce labor turnover.

Man Power in Industry. 658.3
By E. S. Cowdrick. 388 pp. Henry Holt & Co., New York. $3.25. This book contains a large amount of information concerning the principles of human relationships in industry. The subject is relatively new and no fixed standards have been set so the author draws few conclusions concerning the best methods to be used. He merely presents reviews of recent developments in industrial relations with their causes and effects, and permits the reader to decide for himself which methods should be used. There are very few phases of the subject which are not discussed in the book as the following extracts from the table of chapter headings show: organized labor; forms and tendencies; labor supply and immigration; psychological tests and character analysis; the works council in action; guarding the health of the worker; recreation in industry; housing the wage earner; the employees' magazine; profit sharing and supplementary compensation.

Methods of Promoting Industrial Employees. 658.31254
P. F. Gemmill. *Industrial Management* (N. Y.), April 1924, v. 67, pp. 235-247. An exhaustive research into the methods of 150 representative industries showing basis of promotion, how determined, responsibility for, and other factors.

Partnership Not Paternalism. 658.3
Samuel M. Vauclain. *World's Work*, April 1924, v. 67, pp. 659-665. Illus. Some views of the President of the Baldwin Locomotive Works, who believes the days of master and workmen have passed and that partnership of employer and employee will prove of great benefit to industry.

Picking Competent Molders. 658.311563
Russell J. Waldo. *The Foundry*. April 15, 1924, v. 52, pp. 307-309. Trade test method of interviewing applicants, to prove whether the applicant is familiar with methods and machines.

Protection Against Dust and Fumes. 658.3822
R. C. Williams. *Forging, Stamping, Heat Treating*. April 1924, v. 10, pp. 164-167. Dust, smoke, and fumes, as industrial health hazards. Shows the value of scientific investigations in their control.

Relation of Community Health to Personnel Problems. 658.31147
A. E. Shipley. N. Y., American Man

agement Association, 1924. (Convention address series, no. 11). 5 pp. Shows the health of employees influences and is affected by surroundings. Touches on clinics, control of diseases, the value of health statistics, etc.

Relation of the Employment Department to the Foreman. 658.31243
S. R. Rectanus. American Management Association, 1924. 10 pp. Address at American Management Association convention, 1923, followed by discussion.

A Report on Industrial Thrift and Savings Plans. 658.384
Metropolitan Life Insurance Co. Policyholders' Service Bureau. 1924. 12 pp. Outlines the basic principles of a thrift program and describes 12 different plans as applied in particular industries.

Representative Government in Industry. 658.3151
By James Myers. 249 pp. George H. Doran Co., New York. $2.00. In this thought-provoking book the urgent need for closer co-operation between the two human factors in industry is thoroughly discussed. The author recognizes that many concerns have, short-sightedly, adopted selfish methods to control their personnel problems and, on the other hand, that labor is often unfair in its demands. Mr. Myers believes that the only labor policy which can succeed is one based on the idea that labor, management, and capital are real partners in the enterprise, and that nothing can be accomplished unless each of these partners can place implicit faith in the honesty and sincerity of the other two. That such a policy is "good business" is well proved by the numerous reviews of things accomplished in plants governed through such a plan. The author is the Executive Secretary, Board of Operatives, Dutchess Bleacheries Inc., where a partnership plan has been very successful; so he may be considered an authority on the subject. The book is of practical value to industrial workers from the presidents down.

Tuning the Employee Publication Into the Personnel Program. 658.3853
A. H. Carver. N. Y., American Management Association, 1924. (Convention address series, No. 7). 8 pp. Material which can be included to create and maintain morale. Tells of an experiment tried by Swift & Co. Emphasizes the importance of an experienced editor.

Power

Economy of Heavy Oil Engines. 658.26
Charles Day. *The Petroleum World*, April 1924, v. 21, pp. 154-156, 158-160. From viewpoint of a person desiring to put down motive power plant and considering alternative types.

The Executive and His Power Department. 658.26
Miles Sampson. *Textile World*, April 5, 1924, v. 65, pp. 87, 89, 91. For the mill executive who is interested in putting the efficiency of his power department on a par with his manufacturing department.

Lack of Knowledge Principal Cause of Belt Abuse. 658.2621
Wm. Staniar. *Belting, Transmission, Tools and Supplies*, April 1924, v. 24, pp. 19-22. Errors prevalent in many manufacturing plants are due to lack of knowledge of the principles of mechanical power transmission.

Layout of Group and Individual Drives. 658.26
R. W. Drake. *Industrial Engineer*, April 1924, v. 82, pp. 174-177. Illus. Third of three articles on group and individual drives. Suggestions on installation including special features determining the layout of fan drives and the results of tests on lineshaft friction losses.

Modern Maintenance of Plant and Equipment. 658.26
W. G. Ziegler. *Industrial Management* (N. Y.), April 1924, v. 67, p. 224. Illus. Electric power and heating equipment.

No Repair Expense in Three Years of Power Transmission. 658.262
Z. H. Magnum. *Belting, Transmission, Tools and Supplies*, April 1924, v. 24, pp. 28, 30. The installation of silent chain individual motor drives in the Avondale Mills, Birmingham, Ala., increased production 3½ per cent by the elimination of slip.

Power Organization in the Steel Industry. 658.26
Bryant Bannister and F. M. Van Deventer. *Mechanical Engineering*, May 1924, v. 46, pp. 248-250. Compares power requirements of steel works with central stations. The fundamental problem is not one of technical engineering alone, but of organization.

Production Control

Controlling the Flow of Package Products by Materials Handling Equipment. 658.512
Jerome Mendleson. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 545-550. Illus. See Mechanical Handling.

Das Diagramm und seine Verwendung als Anschauungsmittel im Unterricht der Fortbildungs-schule. 658.53
L. Werner. *Werkstattstechnik, Heft 7*, April 1, 1924, v. 18, pp. 209-213. Illus. Value of graphic method of presentation.

Forecasting the Curve of Sales. 658.5
H. R. Simonds. *Iron Trade Review*, April 17, 1924, v. 74, pp. 1043-1045. How the Walworth Mfg. Company developed a budget system of control resulting in a production plan that gave an even flow of material through the year.

Grouping Machines Economically. 658.5
H. M. Groff. *Machinery*, April 1924, v. 30, pp. 583-586. Charts. Investigation of the principles controlling efficient grouping of machines and operations.

Has Psychology a Place in Modern Business? 658.5423
S. S. Rowntree, Jr. *Business Organization and Management*, April 1924, v. 10, p. 25. Stresses the value of training of employees. Half of the article is devoted to motion-study.

Hunting Defects with the X-Ray. 658.562
V. E. Hillman. *Iron Trade Review*, April 24, 1924, v. 74, pp. 1103-1106. Illus. Diagnosis of castings imperfections made possible by Roentgen rays. Position and character of cavities indicates remedies that may be used in each case.

Improving Shop Methods to Increase Production. 658.5
C. A. Handschin. *Western Machinery World*, April 1924, v. 15, pp. 121-122, 127. Illus. Illustrating a group of machine tools used at the plant of the Hall-Scott Motor Car Company in the production of differential casings for the Ruckstell axle.

Maintenance and Adjustment of Steam Engines. 658.581
W. E. Biggs and W. R. Woolrich. *National Engineer*, April 1924, v. 28, pp. 166-169. Practical instructions on adjustments, alignment and general repair.

Making a Reputation for Quality. 658.516
William C. Lyon. *The Nation's Business*, May 1924, v. 12, pp. 64, 66. The malleable iron industry created the American Malleable Casting Association, engaged a high-grade engineer and through its research work has raised the standard of its production on a strictly quality basis.

Making and Using Time Studies. 2-3. Planning the Installation. 658.5421
H. K. Reed. *Industrial Management* (N. Y.), v. 67, April 1924, pp. 231-234; May 1924, pp. 272-278. Investigations necessary as a preliminary to successful time-study installation. And methods of applying time-study under various specific conditions of work: setting time allowances, preparing instruction cards, planning the routine. Forms given.

A Modern Locomotive Boiler Reconditioning Shop, Alsace-Lorraine Railway. 658.58
J. T. Burton-Alexander. *The Engineer* (London), April 18, 1924, v. 137, pp. 405-406. Unusual details of the various steps in the progress of the boiler through the shop by the straight-line system; new features in the processes of repairing tubes.

A Practical Drafting-room System. 658.5
V. B. Black. *Machinery*, April 1924, v. 30, pp. 605-607. Illus. Methods successfully applied in the management of a drafting-room. First of two articles.

Repair and Upkeep of Pneumatic Tools. 658.582
Colliery Guardian, March 28, 1924, v. 127, p. 796. Some practical hints offered by various experts.

Simplifying Cloth but Not Style Increases Volume and Profit. 658.516
August Belden. *Printers' Ink Monthly*, April 1924, v. 8, pp. 56, 59-60. Methods adopted by the Silverstrype Clothing Com-

pany and the favorable results obtained. Principle proved profitable even in highly sensitive style fields.

Some Production Problems in the War Department's Preparedness Program. 658.5
Capt. H. W. Churchill. *Mechanical Engineering*, May 1924, v. 46, pp. 268-271. Plan to establish nation wide co-operation of engineering, industrial, and commercial bodies with the War Department.

Systematic Gage-Checking as a Requisite of Precise Measurement. 658.56
J. Lannen. *Society of Automotive Engineers Journal*, April 1924, v. 14, pp. 407-408. Describes a gage-checking department, how installed, methods used, and equipment necessary.

Why We Pioneered in Simplification. 658.516
Stanley E. Collinson. *System*, April 1924, v. 45, pp. 481-483, 510. Applied to the manufacture of skating outfits.

Wirtschaftliche Ausgestaltung der Vorkalkulation im Maschinenbau. 658.5
Dr.-Ing. Fehse. *Maschinenbau*, March 13, 1924, v. 3, pp. 375-376. Production planning in machine building shops.

Selling

Budgeting and Financing Sales. 658.8
J. G. Frederick. *Advertising and Selling*, April 1924, v. 34, pp. 9, 24. Some practical suggestions, forms, and methods of computation, or budgeting, to give the sales manager a working basis.

Buying Motives for Industrial Good. 658.8
Melvin T. Copeland. *Harvard Business Review*, April 1924, v. 2, pp. 303-318. A study and comparison of buying and patronage motives.

Consult Our Engineers. 658.82
Don Gridley. *Printers' Ink Monthly*, April 1924, v. 8, pp. 21-22, 125. How laboratory experts sent out by the raw material industries give valuable service to manufacturers. Both profit by this service.

The Disgruntled Customer. 658.856
Charles R. Wiers. *Sales Management*, April 1924, v. 6, pp. 771-772, 876. Illus. How to meet complaints without losing friends or accounts. The cost of satisfying the customer comes back through the permanency of his business.

Four Policies that Widened Sales Boundaries. 658.82
J. M. Anderson. *System*, April 1924, v. 45, pp. 461-464, 563. How the Way Sagless Spring Company overcame the difficulty of distant location, established a standard price, chose its distributing merchants and developed a national market.

Selling to a Schedule. 658.8
Lowell R. Butcher. *Business*, April 1924, v. 5, pp. 29-30, 64. Describes the quota method of the Alemite Lubricator Company of Iowa. The plan guides the salesmen, sets a definite mark and provides them with information.

Tendencies in Sales Management. 658.8
Stuart Cowan. *Taylor Society Bulletin*, April 1924, v. 9, pp. 72-85. Influence of the scientific management attitude of mind on selling and advertising. Scientific planning of sales activities and some principles of sales training.

When Does It Pay to Change Marketing Policies? 658.82
D. G. Miller. *Printers' Ink Monthly*, April 1924, v. 8, pp. 43-44, 45. Former successes, policies and conditions should be carefully studied before any change is made.

Why Tempt the Sales Manager? 658.882
J. W. Hallman. *The Credit Monthly*, April 1924, v. 26, pp. 18, 43. Credit department should not be under the control of sales manager who is naturally biased, but under the treasurer of the company.

Technical

Boiler-Room Instruments Induce Efficient Operation. 621.18
Harry H. Bates. *Gas Age Record*, March 22, 1924, v. 53, pp. 353-354. The importance in steam plant operation of the indicating kilowatt meter.

Classification of Power Presses. 621.97
F. R. Daniels. *Machinery*, April 1924, v. 30, pp. 617-618. Illus. A method of classifying by the style of the frame is advocated and described. Scheme is used by the Waterbury Farrel Foundry & Machine Co.

The Cost of Hydro-Electric Power. 621.31(002)
C. V. Christie. *The Engineering Journal*, April 1924, v. 7, pp. 177-180. The effect of power factor, load factor, and diversity factor on the cost of power.

The Cutting of Steel in Scrap Yards. 665.882
B. Heyman. *The Welding Engineer*, April 1924, v. 9, pp. 32-33, 40. Difficulties in the way of estimating costs and other problems characteristic of scrap yard work.

Das Dampfkesselwesen und die Technischen Hochschulen. 621.18
F. Döhne. *Zeitschrift des Vereines Deutscher Ingenieure*, March 29, 1924, v. 68, pp. 310-312. Ways and means of enabling German technical colleges to give more consideration to boiler technique in their curriculum and research departments.

Development of Modern Stamping Practice. 621.96
W. W. Galbreath and John R. Winter. *Canadian Machinery*, April 17, 1924, v. 31, pp. 19-21. Illus. Application of pressed steel in the automobile field and other manufactures. Great savings possible by its replacement of cast iron parts.

Economy of Heavy Oil Engines. 621.43
Charles Day. *The Petroleum World*, April 1924, v. 21, pp. 154-156, 158-160. From viewpoint of a person desiring to put down motive-power plant and considering alternative types.

Der Einfluss der Maschinenausfuhr auf das Gedeihen der Fertigindustrien. 621:38
H. F. Mueller. *Maschinenbau*, February 28, 1924, v. 3, pp. 321-323. Effect of machine export on the home industry of machine construction. Compares English and German policy during past century.

How Modern Machine Tools Cut Costs. 621.9
Electric Railway Journal, March 22, 1924, v. 63, pp. 444-454. Illus. A description of some modern machine tools now in use in electric railway shops, and new uses for old tools.

Is Materials Handling Emulating the Automobile Industry? 621.86
M. W. Potts. *Industrial Management* (N. Y.), May 1924, v. 67, pp. 265-271. See Mechanical Handling.

Maintenance and Adjustment of Steam Engines. 621.1
W. E. Biggs and W. R. Woolrich. *National Engineer*, April 1924, v. 28, pp. 166-169. See Production Control.

Mechanical Control of Boiler Feed Water. 621.18
C. E. Wolff. *Power Plant Engineering*, March 1, 1924, v. 28, pp. 277-278. Requirements in feed-water regulators for effective results. Touches on valve capacity, indicating regulators, dual control.

Mechanical Stoking. 621.18
By David Brownlie. 234 pp. Sir Isaac Pitman and Sons, New York. Illustrated. $1.50. This book presents a review of mechanical stoking methods in use in England. All the makes of stoker equipment on the British market are described in considerable detail with illustrations and diagrams. Following this there is a section devoted to mechanical coal and ash-handling equipment. In closing, the author draws upon his 12 years' experience to outline advantages and disadvantages of stoker equipment and to suggest economies to be gained from mechanical handling.

The Most Efficient Type of Bearing for Paper Machinery. 621.89
G. H. Spencer. *Paper Trade Journal*, April 10, 1924, v. 78, pp. 209-217. Illus. The anti-friction bearing, either of ball or roller type, its manufacture, and its advantages.

Neue D. I. Normblätter. 62(003)
"Dinormen," German engineering standards proposed and adopted each month, appear regularly in *Werkstattstechnik* and *Maschinenbau*.

Die Normung von Transmissionen. 62(003)
H. F. Schindler. *Maschinenbau*, March 13, 1924, v. 3, pp. 373-374. Standardization of transmission parts.

Pipe Specifications and Bills of Material. 621.774
H. C. Collins. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 577-581. Definite directions with many tables.

A Practical Drafting-Room System. 621.75
V. B. Black. *Machinery*, v. 30, April 1924, pp. 605-607; May 1924, pp. 671-673. See Production Control.

The Present Trend of Electrical Safety in Coal Mines. 622.8
L. C. Ilsley. *Journal of American Institute of Electrical Engineers*, April 1924, v. 43, pp. 341-344. Some of the hazards which have come with the introduction of electricity into mining and how to meet them.

Pressed Metal Revolution in Industry. 621.96
A. L. Green. *Forging, Stamping, Heat Treating*, April 1924, v. 10, pp. 140-144. Illus. The important part played by pressed metal in the automobile industry and many others. Great savings effected by standardization and quantity production.

Production Brazing. 665.882
B. Heyman. *The Welding Engineer*, March 1924, v. 9, pp. 19-21 (continued). Standardization of operation conditions in oxy-acetylene welding and better conditions for the operator are necessary for production methods of brazing.

Progress in Prime Movers. 621.31
W. H. Patchell. *The Engineer* (London), March 28, 1924, v. 137, pp. 332-334. Possibilities for electric power production in Great Britain, with special reference to steam turbines and recent developments.

A Radical Change in the Heat Treatment of Cast Iron. 669.1
R. W. Edmonds. *Manufacturers' Record*, April 3, 1924, v. 85, pp. 105-106. Process of "converting" cast iron, invented by Alexander K. Schaap. Produces castings which are softened, yet tougher and more malleable.

The Significance and Status of Super Power Development in the United States. 621.31003
Ezra B. Whitman. *Manufacturers' Record*, March 27, 1924, v. 85, pp. 79-81. The Coal field super-power system covering the area between Cleveland, Ohio; Erie, Pa.; Kentucky-West Virginia state line south of Charleston, W. Va., a point outside of Baltimore and the entire Pittsburgh district. Capitalization, $315,000,000, and a total generating capacity of over 2,000,000 horsepower.

A Study of the Destructive Distillation of Coal. 662.74
Colliery Guardian, v. 127, March 21, 1924, pp. 737-738; March 28, 1924, pp. 797-798. A highly technical study, being a digest of Cantor lectures delivered before the Royal Society of Arts by E. V. Evans, Chief Chemist of the South Metropolitan Gas Co.

The Transmission of Heat in Boilers. 621.18
W. N. Booth. *The Gas World* (England), March 29, 1924, v. 80, pp. 288-290. Calculation of rates of heat transmission. Emphasizes the importance of keeping boilers clean, and shows that the highest efficiency of heat transmission is obtained with the gas-fired boiler.

Werbung als Verbandsaufgabe. 621.87
G. V. Hanffstengel. *Maschinenbau*, March 13, 1924, v. 3, pp. 374-375. Reviews "Deutsche Kranbuch" published by the Deutscher Kran Verband and urges other industrial organizations to consider similar undertakings.

Transportation

Delivering Less-than-Carload Freight by Motor Truck. 656.124
R. D. Sangster. *Society of Automotive Engineers Journal*, April 1924, v. 14, pp. 415-421. The "St. Louis system" of handling freight compared with the system of a universal freight house and the handling of freight by trap-cars.

Keeping Track Machinery "on the Job." 625.1
Electric Railway Journal, March 22, 1924, v. 63, pp. 463-469. Illus. Machines and methods used at Milwaukee in track construction and maintenance work.

Meeting the Shipper on the Industry Track. 625.6
O. F. Scudder, C. L. Whitney and E. D. Swift. *Railway Age*, April 19, 1924, v. 76, pp. 981-984. Three brief articles regarding tracks built to meet the requirements of individual shippers. Considers the need for contracts and the question of operation and maintenance.

Production Methods in British Freight Car Building. 625.2
D. R. Lamb. *Railway Review*, April 19, 1924, v. 98, pp. 717-722. Illus. Gives the operations in their proper sequence for building a standard 12-ton open freight wagon. A key plan of the assembly unit is given and labor-saving appliances are described.

Ramifications of the Freight Rate. 656.235
Michigan Manufacturer, April 5, 1924, v. 33, p. 5. How charges are fixed and what factors enter into a fair freight schedule.

Railroad Traffic and the Business Cycle. Pt. 2. 656.22
Homer B. Vanderblue. *Railway Age*, April 5, 1924, v. 76, pp. 885-888. Relationship between railroad car loadings and the business cycle, as an aid to the railroad executives in judging the probable effect of changes in business conditions upon the demand for a particular kind of service.

Wages

An Analysis of All Plans that Have Been Used in Paying Salesmen. 658.32
C. K. Woodbridge. *Printers' Ink*, April 24, 1924, v. 127, pp. 113-116. An outline of sales compensation experience as given before the American Management Association's Sales Executives Convention at Chicago.

A Bonus Plan that Encourages Year-Around Work. 658.3225
A. E. Simmons. *System*, April 1924, v. 45, pp. 490-491. Method used by the M. L. Parker Company provides a constant incentive. There is a chance to get a bonus each month. Selling costs were decreased.

Financing Benefit Systems. 658.325
Addresses by H. A. Ley, R. S. Quinby and J. H. Woodward. N. Y. *American Management Association*, 1924. (Convention address series, No. 8). 14 pp. Takes up three types, those financed 50-50 by employees and company, and those financed entirely by employees.

Group Life Insurance on 27 Railroads. 658.3253
Railway Age, April 5, 1924, v. 76, pp. 881-883. List of roads on which such insurance is in force; with notes on differences in details.

Lohnfragen. 658.32
H. Distel. *Werkstattstechnik*, Heft 7, April 1, 1924, v. 18, pp. 217-219. Wage systems: payment by piece, by unit of time, and other wage regulations.

Machine Shop Wages Compared. 331.2
Iron Trade Review, May 1, 1924, v. 74, pp. 1167-1169. Wage trends as indicated by a survey of wages in metal working plants and the steel industry in the United States, made by the National Industrial Conference Board.

The Trend of Prices and Wages. 338
J. D. Cox, Jr. *Open Shop Review*, April 1924, v. 21, pp. 125-132. Attempts to show that high wages are not the cause of our high standard of living but both high standard of living and high wages are the result of our high productivity.

Wage Incentives and Profit-Sharing. 658.324
G. C. Brown. MANAGEMENT AND ADMINISTRATION, May 1924, v. 7, pp. 567-572. Where operations can be readily time-studied a wage-incentive plan is advocated, but where operations are not susceptible to such study the profit-sharing plan is to be preferred.

Wage Policies and National Productivity. 331.214
S. A. Lewisohn. *Political Science Quarterly*, March 1924, v. 39, pp. 97-105. Some considerations one should give to the interpretation of statistics.

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2. "Mechanical efficiency of over 80%."
3. "Only the best materials and finest workmanship are used in its construction."
4. "Frictional losses are reduced to a minimum by the use of Hyatt 'High-Duty' bearings throughout."

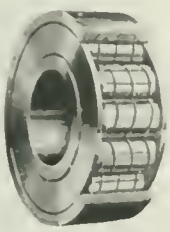
Note—

Hyatt roller construction makes them self lubricating and self cleansing. Some Hyatt bearings have been operating over 33 years without appreciable wear.

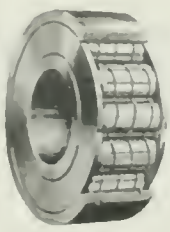
True rolling motion of Hyatt bearings reduces friction 50% to 75%.

Hyatt rollers are made of chrome-alloy steel, hardened and ground. Hyatt races are of high carbon steel in all cases

Actual tests under operating conditions show that substantial power savings result from the use of Hyatt roller bearings on trolleys, cranes and hoists.



You can obtain fully dependable and economical material handling machinery by specifying "Equipped with Hyatt roller bearings."



HYATT ROLLER BEARING COMPANY

NEWARK DETROIT CHICAGO SAN FRANCISCO
HUNTINGTON PHILADELPHIA PITTSBURGH MINNEAPOLIS
WORCESTER BUFFALO CLEVELAND MILWAUKEE

CONSULTATION IN COSTS

THEIR CONSTRUCTION AND USE

FOR MANAGERIAL PURPOSES

WHY spend a lot of money in compiling figures and get but little benefit therefrom?

WHY not have your engineering department draw pretty pictures and not real usable designs?

WHY let your department heads work blindly when they can just as easily work with facts?

WHY not release latent cost reducing forces by proper use of cost data?

IT COSTS NO MORE TO HAVE USABLE COST FIGURES, and to USE THEM. *Why do otherwise?*

A leaflet called "COST CUTS" is issued about every two weeks, each giving an actual example of how some cost has been cut through using cost figures. These will be mailed on request without any obligation whatever.

This service is within easy reach of smallest company
Full information on request

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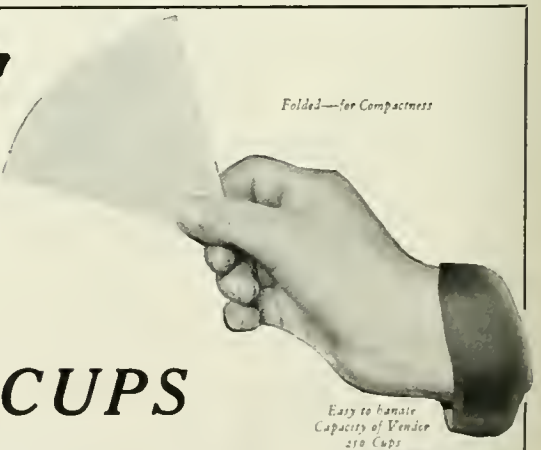
Vortex

SANITARY DRINKING CUPS



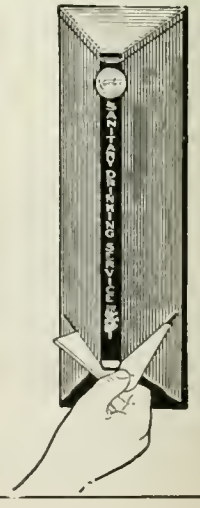
Particular people prefer Vortex Paper Drinking Cups —for cleanliness, health and safety.

Every factory—every office—every place where water is dispensed needs them.

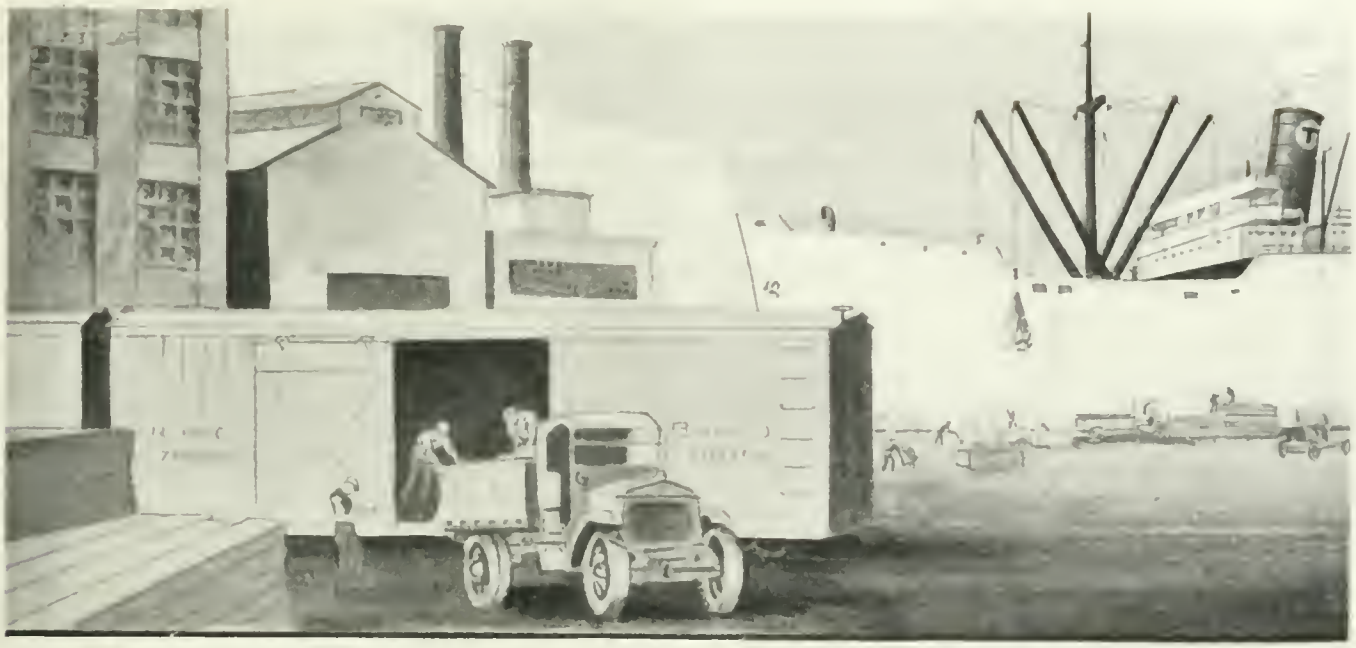
Vortex Drinking Cups are made from a superior grade of bleached sulphite paper, thoroughly saturated with fully refined paraffine wax. Absolutely tasteless, odorless and sanitary. Compact, dainty, rigid and efficient; will not collapse in use; waterproof for 24 hours.

Their low cost makes them the logical successor of the old-fashioned community drinking glass or cup.

Write for complete description, prices and samples.



THE VORTEX MFG. CO.
421-431 N. Western Avenue
Chicago Illinois, U. S. A.



A *Recognized* Manufacturing and Distributing Center

The following manufacturers, many of them nationally known, distribute their products from Port Newark:

A. A. Wire Co.
Armour Soap Works
P. Ballantine & Sons
Beckwith Chandler Co.
Central Stamping Co.
Chalmers Chemical Co.
Corn Products Ref. Co.
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Fairbanks Co.
Gilchrist Co.
Heller Bros. Co.
Hooton Chocolate Co.
Johns-Manville Co., Inc.
Keratol Co.
Mennen Company
Mono Service Co.
Murphy Varnish Co.
Nitrogen Electric Co.
Patton-Pitcairn Division (Pittsburgh Plate Glass Co.)
Rauchback Goldsmith Co.
Royal Electric Lab. Co.
Sherwin-Williams Co.
J. L. Sommer Mfg. Co.
L. Sonneborn & Sons
Spratts Patent, Ltd.
Sterling Leather Co.
United Color & Pigment Co.
U. S. Leather Co.
Wesley & Winter
Westinghouse Elec. & Mfg. Co.
Worthington Pump Works
Zeller Lacquer Co.

The advantages offered by Port Newark to the manufacturer or shipper are identically the advantages that he would secure by locating in the heart of the metropolitan center of New York.

There are the unlimited rail connections (seven trunk lines); the extensive highways; the deep-water shipping facilities; the proximity to the greatest cities of the east; the advantage of being located at the market center of the world; and of being able to effect distribution, by the quickest and cheapest means, to the richest primary markets of the nation.

And all of these advantages are yours at Port Newark—in the *heart* of New York's harbor district—at a *fraction* of the cost for land or rentals that you would pay elsewhere in the metropolitan area.

Some of the greatest manufacturers of the country have already recognized the importance of Port Newark in relation to their business. The future expansion of *your* business may be assured by the proper location. Why not consider Port Newark now?

All the information you would need in considering Port Newark's possibilities for your business is contained in the comprehensive free book, "Port Newark." We will gladly mail you a copy. Write for it to-day.

THOS. L. RAYMOND, Director
Department of Public Improvements Newark, N. J.

PORT NEWARK

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The Ronald Press Company, Publishers, 20 Vesey Street, New York, N. Y.

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To maintain maximum plant output, each productive unit must be kept at top speed, all the time. Only the best machines, with maximum wear resistance, can stand this speed service. Precision—everywhere desirable in a high-duty machine—is fundamentally requisite in the bearings, where the heaviest friction load most usually be carried. For inaccuracies of small moment at moderate speeds, manifest themselves at high speeds in destructive vibration, with excessive friction and wear.

"NORMA" BALL BEARINGS

OPEN AND CLOSED TYPES

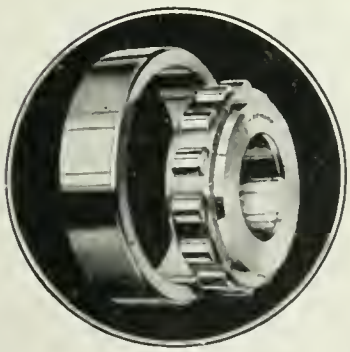
OPEN TYPE

Experience has proved that these high-precision units are preëminently adapted to conditions where maximum serviceability and freedom from vibration are sought, under high-speed operation. They have all the load-carrying capacity of any ball bearing, with a speed-ability which no other ball bearing possesses. They have long been the standard bearings in all high-grade automotive magnetos and lighting generators. And other notably successful applications are wood-working machinery, high-speed grinders, drills and other tools, fractional h. p. motors and electrical utilities, recording instruments, etc.

CLOSED TYPE

HOFFMANN ROLLER BEARINGS

STANDARD AND SELF-ALIGNING



STANDARD

These high-precision, heavy-duty units are designed for conditions involving heavy loads, shocks, jars and vibrations. They have all the speed-ability of the best ball bearings, with a much greater steady load-carrying capacity and with a temporary overload capacity, as under shocks and in starting, which no ball bearing has. They are made in the same standardized sizes as ball bearings, and can be had in both standard and self-aligning types—some of the latter being wholly enclosed and lubricant-packed. "Hoffman" Roller Bearings have brought high anti-friction bearing economies into the heavy-duty field where they were never before available.

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"NORMA" engineers will welcome an opportunity to work with yours, in applying these high-precision bearings with a view to increased production, greater power saving, and reduced up-keep costs.

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Public Utility and Industrial Corporations are invited to submit their problems to us when new financing is under consideration.

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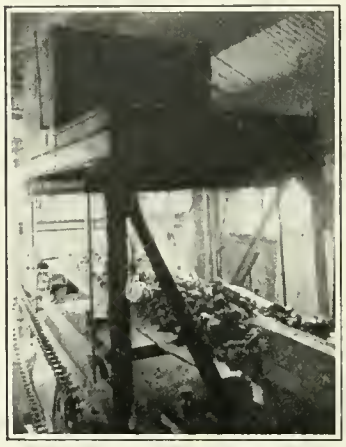
Any material handled on a belt-bucket or pan conveyor fitted with **MERRICK WEIGHTOMETER** is automatically weighed as it moves along. The scale is always on the job—it makes no slips—it's honest—and its totals at the end of the day are accurate and they require no special attendant.



TYPICAL INSTALLATION

Material being handled over Weightometers

COAL
ORES (all kinds)
CEMENT
SHALE
CLINKER
ROCK
GYPSUM
FISH
FERTILIZER
PHOSPHATES
SAND
PAPER MILL PRODUCTS
HOG FUEL
SALT
ETC., ETC.

MERRICK SCALE MANUFACTURING CO.

186 Autumn Street, Passaic, New Jersey

Seamless Kantainer

Meets factory needs. Pressed from one sheet of cold rolled steel—it can't crack, break or leak. No seams to open. Lasts as long as your plant.

Factories, large and small, have adopted it for—holding parts; catching steel shavings; catching oil drip; delivery containers, etc.

Seamless KANTAINER Milwaukee

Sold only direct from our factory to you. Comes in five sizes. 26-gallon Kantainer sent on 10 days' free trial, you pay express. Use Request Coupon below.

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Street .....
City ..... State .....

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To show the condition of Distributing Points; where salesmen are; where business is active or quiet or where new business is awaiting you—this can be seen at a glance on Map or Chart by using

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50 Colors 5 Sizes 1000 Symbols

Send One Dollar for Cabinet of Maptacks—10 different Colors, with simple directions, and suggestions how to use them.

A copy of "System Simplified" with Samples FREE.

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Indicators for your Card Files that "Tell you when to act;"

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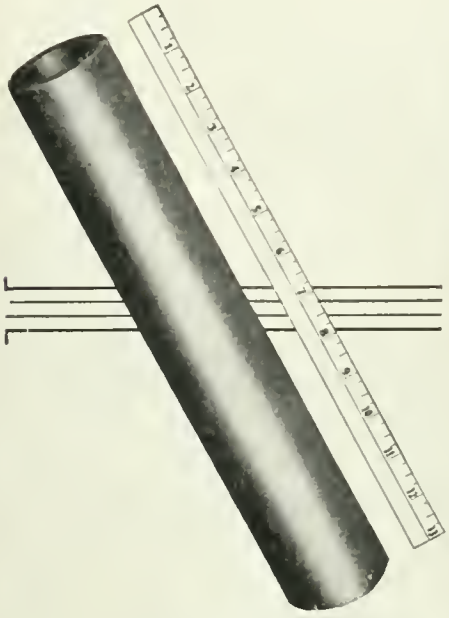

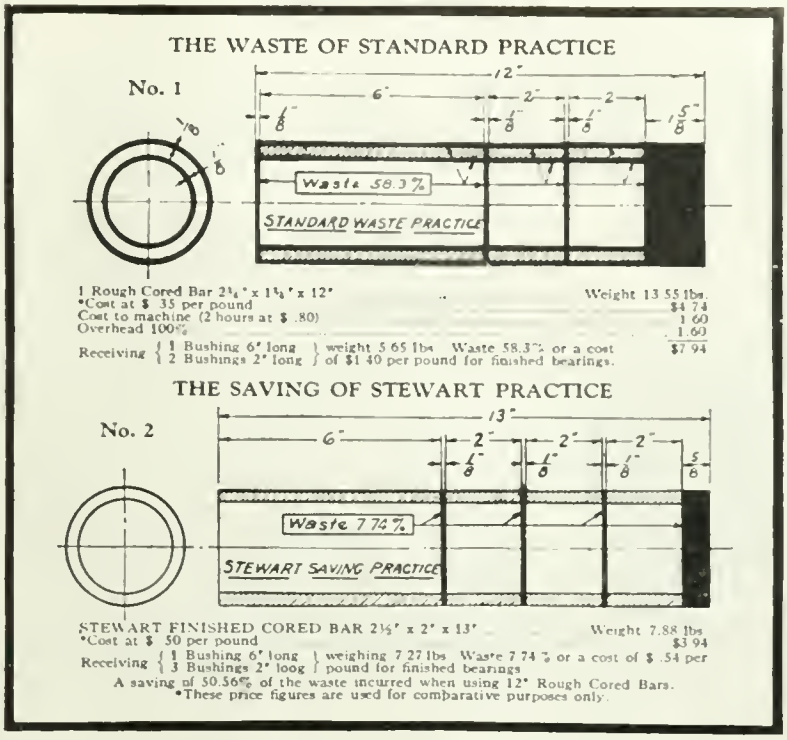
THE WASTE OF STANDARD PRACTICE
No. 1
12"
6"
2"
2"
1/8"
1/8"
1/8"
5/8"
Waste 58.3%
STANDARD WASTE PRACTICE
1 Rough Cored Bar 2¼" x 1¼" x 12" Weight 13.55 lbs.
*Cost at $ .35 per pound $4.74
Cost to machine (2 hours at $ .80) 1.60
Overhead 100% 1.60
Receiving 1 Bushing 6" long, 2 Bushings 2" long weight 5.65 lbs. Waste 58.3% or a cost of $1.40 per pound for finished bearings. $7.94
THE SAVING OF STEWART PRACTICE
No. 2
13"
6"
2"
2"
2"
1/8"
1/8"
1/8"
5/8"
Waste 7.74%
STEWART SAVING PRACTICE
STEWART FINISHED CORED BAR 2½" x 2" x 13" Weight 7.88 lbs.
*Cost at $ .50 per pound $3.94
Receiving 1 Bushing 6" long, 3 Bushings 2" long weighing 7.27 lbs. Waste 7.74% or a cost of $ .54 per pound for finished bearings
A saving of 50.56% of the waste incurred when using 12" Rough Cored Bars.
*These price figures are used for comparative purposes only.

13-Inch Bars!

Save 50% on Bars and Bushings

What Stewart Brons Metal Is

The perfect copper-lead mixture that will not segregate. Under successive remeltings, the union of metals is even closer. Sweats a little lead of 600° F., lubricating itself. Will not score shafts up to 1000° F. Melts at 1700° F. Coefficient of friction very low. Made in 258 stock sizes, finished all over, in four degrees of Brinell hardness for all bearing conditions—our standard Grade "D" Metal is perfect for the average bearing requirement. All solid and cored bars 13-inch lengths!

That chart above tells the whole story! Bearings are generally made in 2-inch or 3-inch lengths or multiples of those numbers, aren't they? And in cutting off the bearings and finishing the ends, you lose some of the metal, don't you?

As a result, you only get approximately 10 inches of bearings out of a 12-inch bar. You can get 12 full inches of bearings out of a Stewart 13-inch bar.

Is it worth your while? Just study that chart. Stewart bars are finished all over. That not only saves you machining costs and metal loss but insures you absolute uniformity in your metal. Stewart Brons is the greatest copper-lead mixture ever developed. When we first brought it out, it was bought because of its saving in the 13-inch size. *Now* it is being bought as well for its service as the *perfect bearing metal.*

JOBBERS! We have a great opportunity in a few remaining territories. We're showing big sales increases. Write for particulars to

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The Perfect Metal for Bearings

CHOSEN

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" . . . the work accomplished by your people was satisfactory in every way. . . ."

Atlas again proved itself capable of meeting any demand, and can relieve *you* of the inconvenience, expense and risk of hiring unproven operators, and of the confusion and delay of overworking your permanent calculating department.

When next you need dependable figures available at a certain time give us the opportunity of telling you more about such service as we are equipped to render.

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O-S DEPENDABLE
CRAWLING TREAD CRANE

IT GOES WHERE YOU WANT IT TO GO

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Piedmont Labor Proves the Best in America

THE Piedmont cities of North Carolina have been blessed, up to the present moment, with an adequate supply of intelligent, native white labor. Manufacturers who locate here for some time to come can count upon this same native stock for their help.

North Carolina was settled in the eighteenth century by sturdy Scotch-Irish and English stock. Later came an admixture of German, Dutch and French families from the Northern colonies. For two and a half centuries, these people have lived a rural, religious, simple life. They are independent of thought and action, they are opposed to socialism, communism or syndicalism, and have no time for agitators.

These are the people who have made the Southern factory efficient.

The manufacturer who locates on the Piedmont Plateau finds many other advantages. He is amid the cotton fields and close to the other raw materials of farm, forest, mine and fishery. Linked together in one great system, the hydroelectric power stations of the Southern Power Company all ever the South furnish a service that is never interrupted.

The country is in the exact middle of the East and has good rail connections with all of the great markets.

Best of all, the climate is equable, without extremes winter or summer, and outdoor life can be enjoyed the year around. It is a climate most conducive to the health of both worker and manufacturer and a big factor, therefore, in the success of industrial plants. A person who lives anywhere in North Carolina is close to famous summer resorts and winter resorts, the best of hunting and fishing.

Cities of Leadership

HIGH POINT—Second Greatest U. S. Furniture market. Million dollar Southern Furniture Exposition Building, six acres of floor space, largest of its kind. Value of annual products, $30,000,000. Has an industry to every 170 people, more than known in any other city of its size. Estimated population, 25,000. Eighty per centfown their own homes. Textile industry almost as great as furniture industry. 940 feet elevatioo. Mean annual temperature, 58.

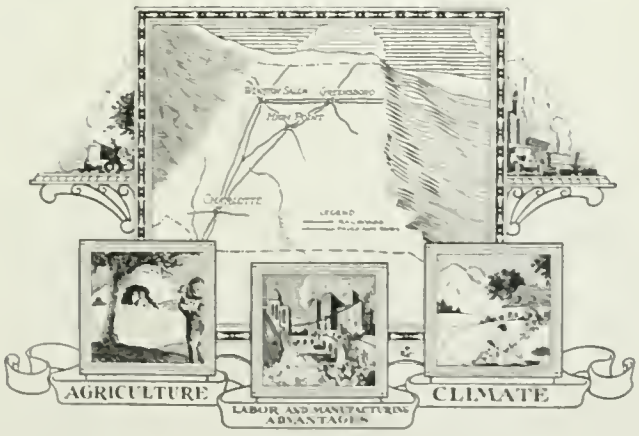
GREENSBORO—World's greatest denim production. Largest exclusively canton flannel industry. Insurance center of the South—four life companies and four fire companies have home offices. Greensboro cotton merchants buy one million bales cotton annually. Same quantity spun within 75 miles. Noteworthy business men's city government. Elevation, 843 feet. Estimated population, 48,000.

CHARLOTTE—Distributing center for two Carolinas. A railroad center. Home of the greatest hydroelectric power development in the country—the Southern Power Company. Center of Southern Textile Industry—737 mills within 100 miles, operating 10,000,000 spindles. Estimated population, 65,000. Elevation, 780 feet. Annual mean temperature, 60. Has 200 sales headquarters or branch houses for distributing goods.

WINSTON-SALEM—Originally settled, 1766, by a Moravian colony seeking ideal agricultural and climatic conditions. Elevation, 893 feet. Estimated population, 75,000. World's greatest tobacco manufacturing city. Pays more tobacco tax than any state. Country's largest manufacturer of men's knit underwear. Smallest city tax rate in the state. Leads South in making of tires, wagons, woolen goods. Third city in the South in value of manufactured products. Pay-roll, $20,000,000

All these four cities have unlimited power, ample native white labor, almost no foreign-born population; fine, new, modern hotels, country clubs, high-class educational institutions, wonderful climate, permitting outdoor life the year around, close proximity to famous summer resorts and winter resorts.

The PIEDMONT PLATEAU
Workbench of North Carolina



A letter to each of the cities listed below will bring all of the facts and data that a business man would require.

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Address Chamber of Commerce

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Greensboro — Winston-Salem

North Carolina

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Whether your difficulty is analyzing a credit statement, deciding on a depreciation policy, organizing a stenographic department, training a sales force, or any of a

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7. Elements of Bond Investment—*Sakolski*
8. Organizing the Stenographic Department—*Gallowa*
9. Report Writing—*Fitting*
10. Profitable Management—*Nicholson*
11. Finding Your Job—*Shidle*
12. Credit Insurance—*Ackerman*
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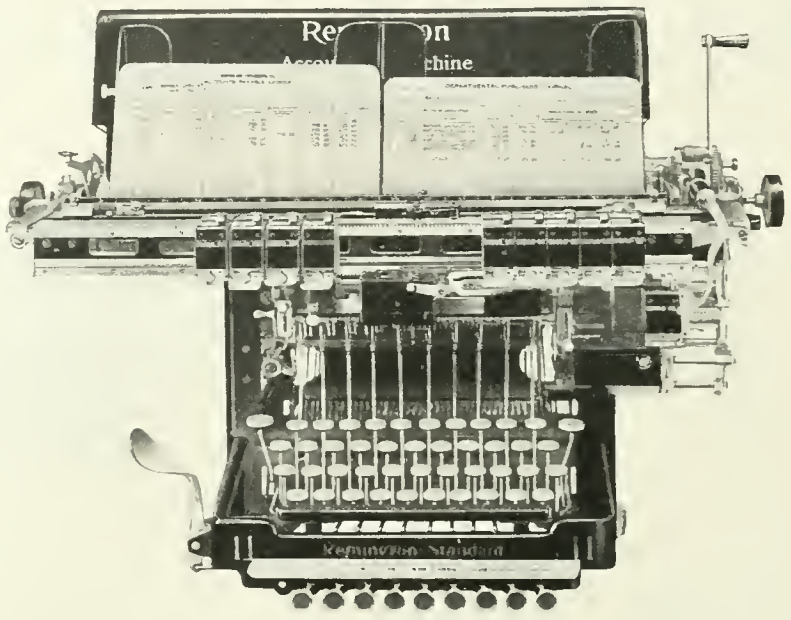

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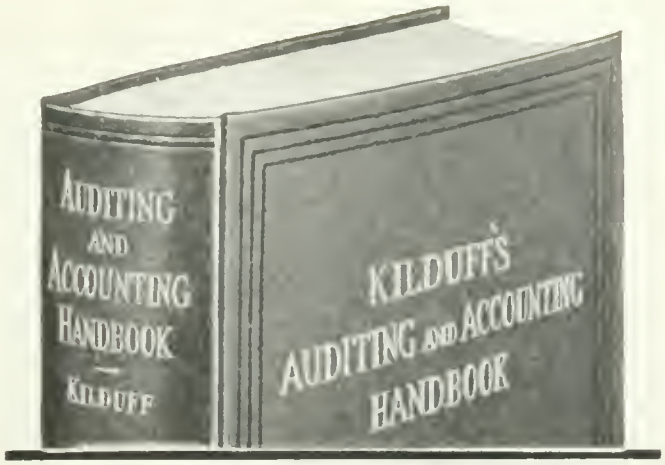

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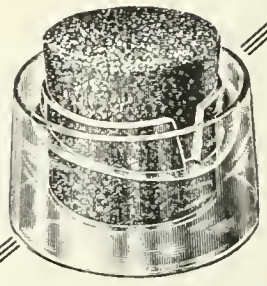

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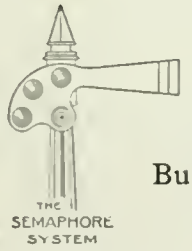

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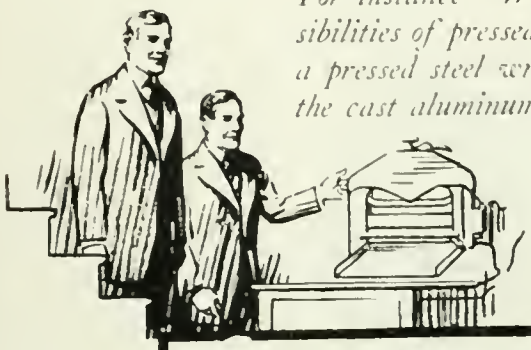

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Ronald Press Co., The
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R

Radiator Traps
Sarco Co., The

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S

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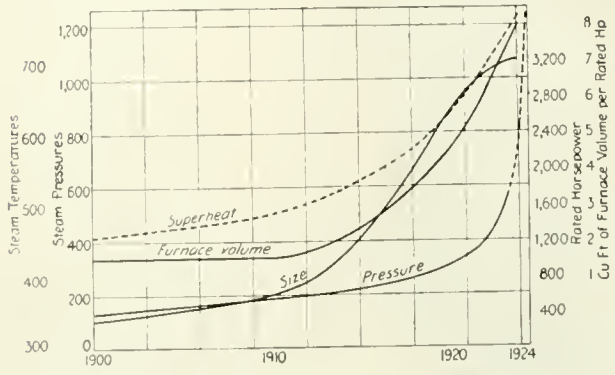
A prominent power plant engineer recently said—"We have quit buying boilers by the horse power. Now we only buy pressures."

The accompanying diagrams indicate to some extent what he meant. They show the progress and tendency in average boiler sizes, pressures, furnace volumes, turbine capacity and steam temperatures from 1900 to 1924.



Progress and tendencies of steam pressures and temperatures compared with boiler designs.

As a matter of fact this engineer's statement was not quite complete. If he had said "We buy only vapor pressures and velocities," it would have been more conclusive.

Like most of us, he was probably thinking of the turbine as the principal prime mover in the modern power plant. In a turbine the velocity energy of vapor is converted into energy of rotation. Heat is only incidental as the means of producing the requisite volume of vapor under sufficient pressure to give it velocity energy when the pressure is released and the vapor expands.

The vapor he had in mind was water vapor and he knew that if he had it under high pressure, it would expand into a larger volume and go through the turbine faster.

He was certainly not thinking about water or he would have modified his statement in some such way as suggested above.

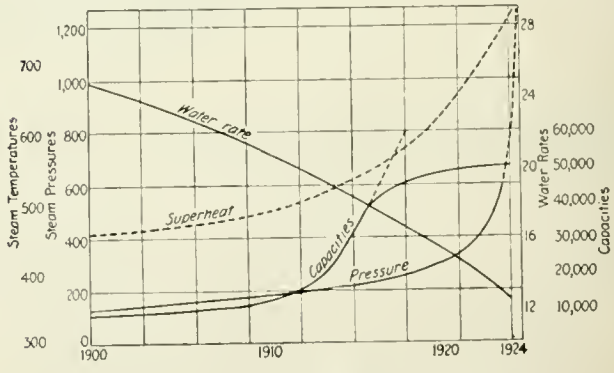
Let us suppose the water vapor he was thinking of was saturated steam at 215 lb. gage pressure. The volume would be 2 cu. ft. per lb.

But saturated steam will condense when it comes in contact with anything that absorbs heat as do the metal turbine parts.

If we go the limit and assume that all the steam condenses instantly on entering the turbine, the volume as water would be only 0.02 cu. ft. per lb. Under these conditions, the velocity would be negligible and the turbine would be practically a condenser instead of a prime mover.

He was certainly thinking of buying something under pressure which would remain a rapidly moving vapor during as great a part of its travel through the turbine as practicable.

He was thinking of and bought superheated steam at 215 lb. gage pressure with 150 deg. superheat because he knew that he would have a volume of 2.5 cu. ft. per lb.; that the steam would remain a vapor until it gave up its superheat; that he would save 15% in the amount of steam needed and consequently require a smaller con-



Progress and tendencies of steam pressures and temperatures compared with turbine designs.

denser; that he would save 6% in fuel; that the steam would go through the high pressure stages of the turbine free from water which erodes the turbine buckets and reduces their efficiency and life.

These are but some of the reasons why superheated steam is essential in power station designs. The engineers of The Superheater Company, 17 East 42nd Street, New York, are prepared to go more fully into the matter of superheating steam with those interested.

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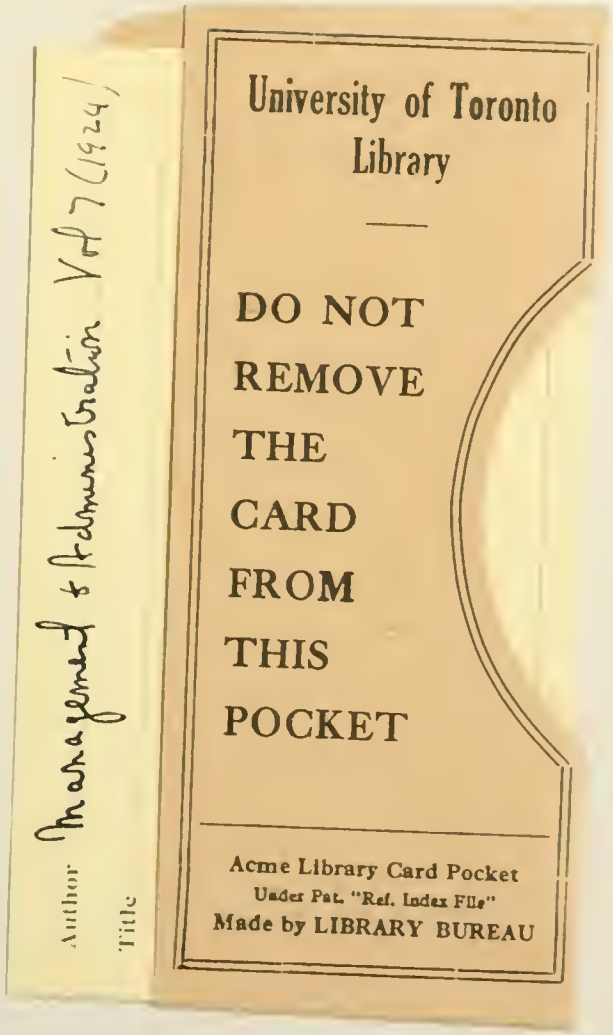
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